

Machinery

A black and white photograph showcasing various industrial components. In the upper center is a large, circular grinding wheel with a central hole. To its right is a metal shaft. Below the grinding wheel is a ball bearing. In the foreground, an open box of MRC bearings is shown, with one bearing resting inside. The box lid features the MRC logo and the text 'SUPER-PRECISION BALL AND ROLLER bearings'. The background is a plain, light-colored surface.

MARLIN-ROCKWELL CORPORATION, JAMESTOWN, N. Y.

See advertisement Page 32



A NEW TOOL-SETTING METHOD

Tool-Tronic Gage locates tool tip within .000025 by fast, simple electronic-optical method

by Alden H. Jacobson, Chief Engineer

Bore-Matic Division

The Heald Machine Company

With today's trend to greater accuracy and precision in single-point Boring, the problem of precise tool-tip location becomes increasingly important.

Previous methods, while of high accuracy, are relatively slow and require considerable skill on the part of the operator. The optical method, using a precision-calibrated microscope, is dependent on the relative degree of operator eye fatigue. If eyestrain is a result, such an undesirable condition is known as "eyeballing." And the touch method, using dial indicators, often causes microscopic damage to the cutting edge with resulting impairment of the finished surface.

Here at Heald we have devoted a great deal of research to devise a method of tool-setting which would maintain the highest accuracy, prevent tool tip damage, and require no special operator skill.

The result is the new Tool-Tronic Gage illustrated here. Tool tip location is precisely determined by optical means, with electronic amplification giving highly accurate readings on two large meter scales.

The unit consists essentially of a sensing head which contains the light source, optics and photo cells, and a separately mounted amplifier and meter case. The sensing head is mounted vertically on the

machine near the workhead, where the tool can be positioned into gage opening. As the tool is moved into place by operation of the table and cross slide, it interrupts the light rays and the amount of light passing on each side of the tool is compared to reference photocells and read out on two large horizontal-scale meters. To locate the tool with an accuracy of 25 millionths, it is only necessary to move tool in X and Y directions until the pointers on both meters are centered on the "zero" mark. For the operator to determine this precise position and return to it whenever desired requires no more skill or experience than that needed to operate the machine.

The Tool-Tronic Gage can be used with most types of single-point boring and turning machines. It should prove especially valuable on numerically-controlled contour Boring equipment where extreme precision is required.

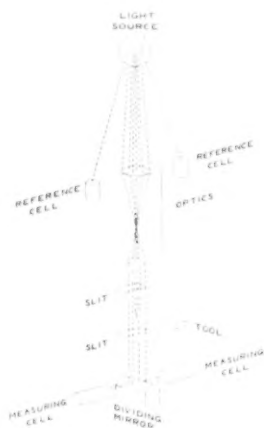


Diagram showing principle of operation of Tool-Tronic sensing head.



Tool-Tronic Gage, showing meter case, sensing head and cable.



Tool-Tronic gage in use on a numerically-controlled Heald Model "S" Bore-Matic. Sensing head (arrow) receives tool and centering indication is read on meters at right.

Your Heald engineer will be glad to arrange a demonstration of this new tool setting gage for you, in your plant or ours.

It Pays to come to Heald

THE HEALD MACHINE COMPANY

Subsidiary of The Cincinnati Milling Machine Co.
Worcester 6, Massachusetts

Machinery

OCTOBER 1961

VOL. 68 No. 2

THE MONTHLY MAGAZINE OF ENGINEERING AND PRODUCTION
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MACHINERY

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and

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London, N.W. 1, England

France
LA MACHINE MODERNE
15, Rue Bleue, Paris-IX*, France



SHOP PRACTICE

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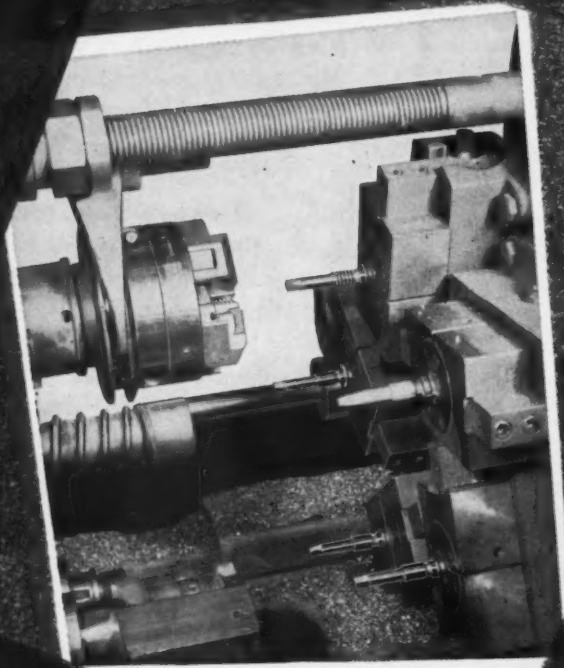


READERS' SERVICE CARD

191

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249



IT'S TRUE



acme threads produced at 900 R.P.M.

TRUE! A LANDIS LANDEX Heat-Treated Die Head is producing Modified Acme threads on valve stems at the rate of 900 R. P. M. at the Sterling Brass Company, Cleveland, Ohio. ■ .570" diameter, $\frac{1}{8}$ " pitch— $\frac{1}{4}$ " lead modified Acme threads, $\frac{3}{4}$ " long are cut on cast brass by the model 10JN $1\frac{1}{4}$ " LANDEX Head—mounted on a 6" x $6\frac{3}{4}$ " Goss and De Leeuw Automatic Chucking Machine in third position. Besides the outstanding cutting speed, the efficiency of the LANDEX Head is further brought out by the fact that a 30° short throat chaser is used and threading is close to a shoulder. 300 pieces are produced per hour and an above average chaser life of 5000 pieces between grinds is achieved. ■ Naturally, the 900 R.P.M. cutting speed saves time and reduces the overall cutting cost considerably. Thread finish is excellent, adding to the more than satisfactory performance of the LANDEX Head. ■ LANDEX Die Heads can give this kind of positive performance in your plant too. They are designed for application to bar automatics and other "live" spindle machines, and have ample head rigidity to allow for a long life and high quality thread production. They offer low initial cost, permit rapid set-up, give trouble-free operation, and are easy to adjust. LANDEX Heat-Treated JN Heads are available in four sizes for threading all diameters from #4 to 2".

LANDIS Machine COMPANY WAYNESBORO • PENNSYLVANIA
THE WORLD'S LARGEST MANUFACTURER OF THREADING EQUIPMENT

616C

NOW...A Larger Capacity FELLOWS-PFAUTER High-Speed Hobbing Machine...The P 630

You get all the advanced-design features of the production-proved P 400 Fellows-Pfauter hobbing machine — plus extra work capacity — with the new Model P 630. Takes work up to a diameter of 25". Maximum face width at 25" diameter is 16 $\frac{1}{4}$ ". Maximum diametral pitch in steel is 3. It's fast, easy-to-handle . . . and it's built for high production.

For example: Work area is readily accessible for setup and loading. Table retracts automatically from hob to facilitate work changes. Hob shifting is controlled by pushbutton. And built-in hydraulics assure smooth operation of tailstock and fixtures.

Solid construction features include: rugged hob head and double wall construction column and bed, with heavy V-ways. Table is as large as maximum workpiece diameter, and index worm gear nearly as large as work table. Work column is of massive design.

Reduce your production costs with this new Fellows-Pfauter. Get complete details now.

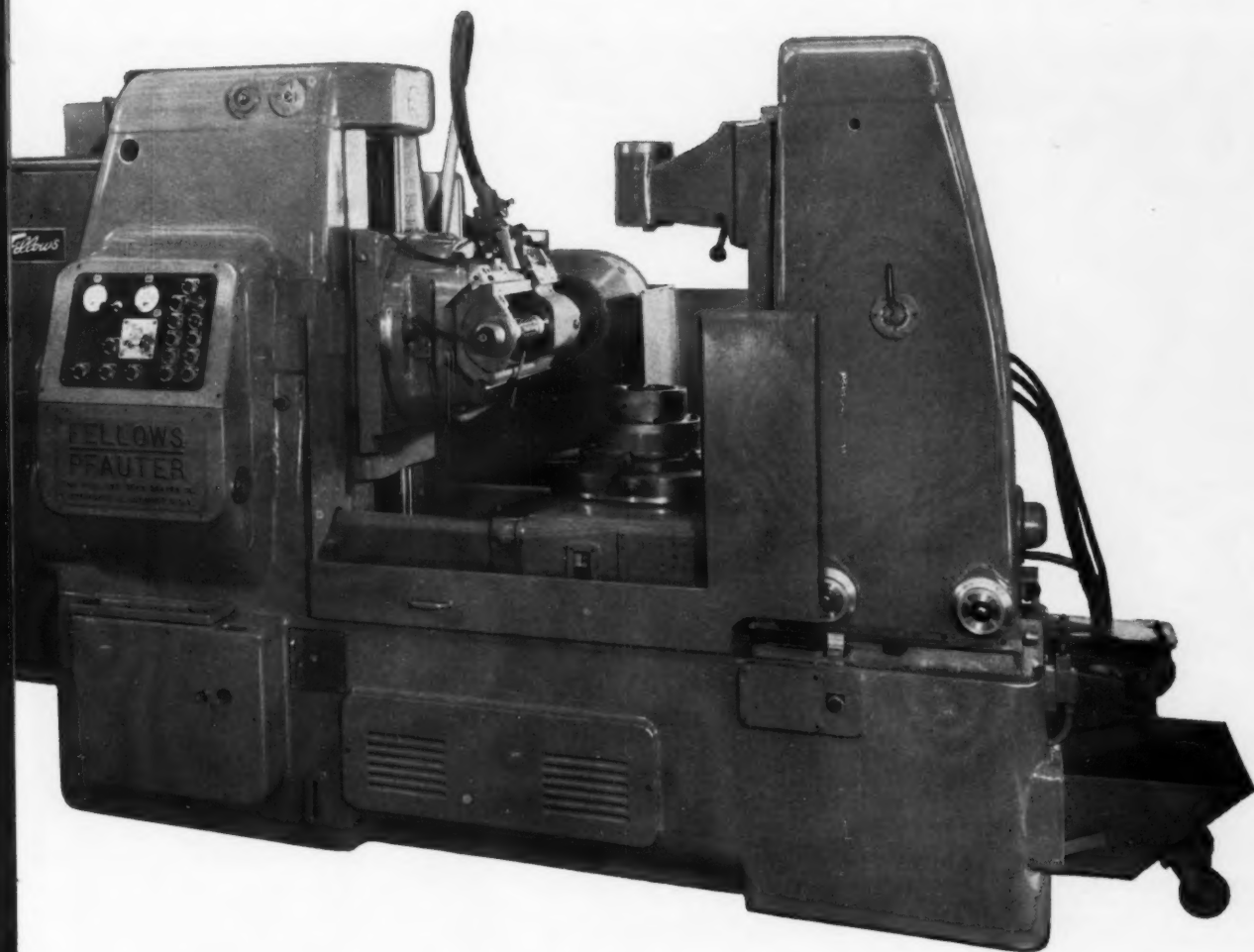


NEW . . . Dictionary of Change-Gear Combinations

Eliminate tedious calculations and trial-and-error methods for finding change gear combinations. Now, simply look them up like words in a dictionary in "Fellows-Pfauter Change Gear Tables" by F. Becher

and A. Koerner. This English edition contains combinations for more than 26,000 ratios carried to six decimal places from .100,000 to 1.000,000, with the greatest step approximately .00005. Change gears in the range of 18 to 80 teeth are mainly used. Examples of applications are given. Only \$8.00. Get a copy now. Send your order to THE FELLOWS GEAR SHAPER COMPANY, 78 River Street, Springfield, Vermont, U. S. A.





THE FELLOWS GEAR SHAPER COMPANY
78 River Street, Springfield, Vermont, U. S. A.

Branch Offices:

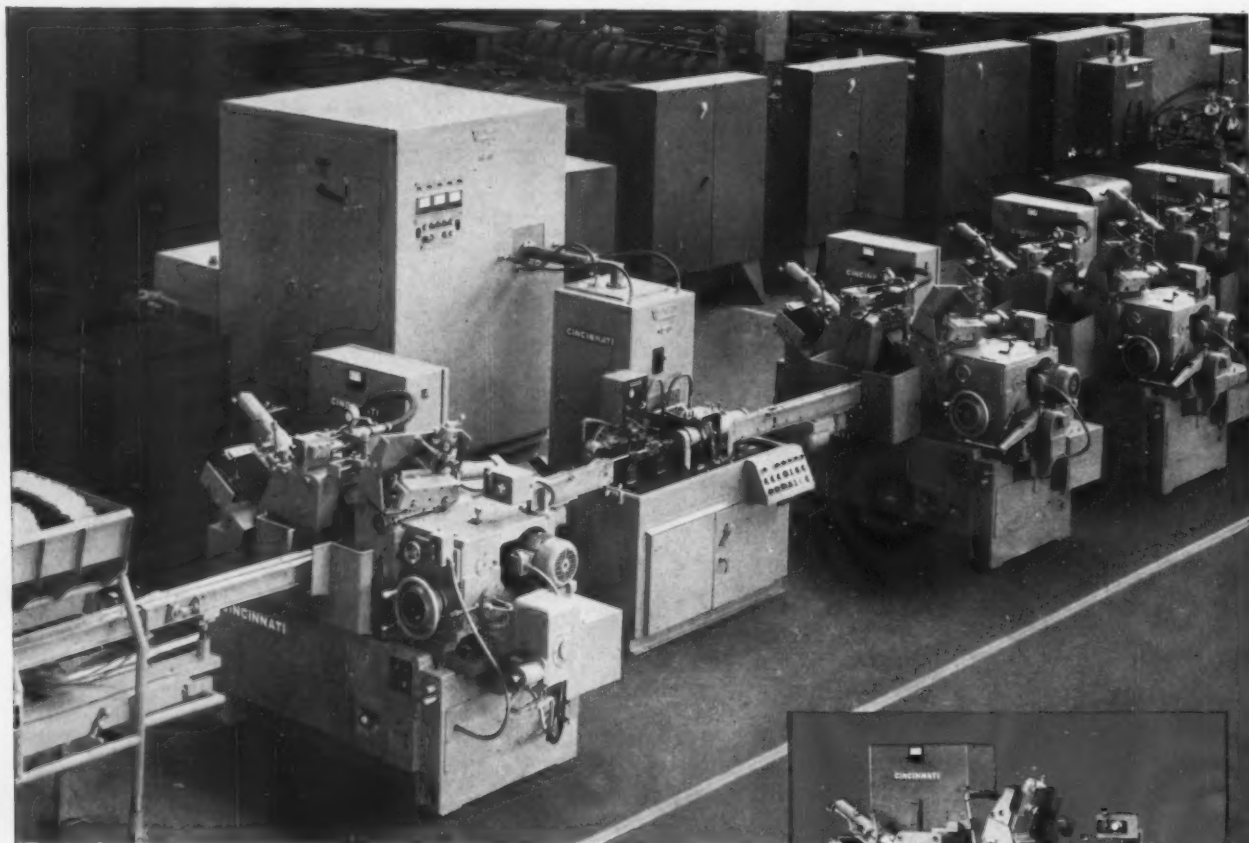
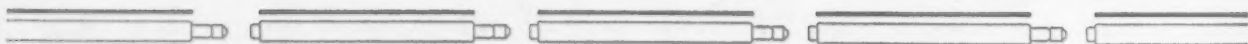
1048 North Woodward Ave., Royal Oak, Mich.
150 West Pleasant Ave., Maywood, N. J.
5835 West North Avenue, Chicago 39
6214 West Manchester Ave., Los Angeles 45

THE
PRECISION
LINE

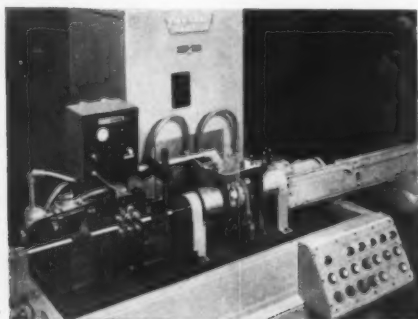
Fellows

Gear Production Equipment

Twelve linear feet of parts every minute



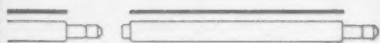
Continuous production of shock absorber piston rods is achieved on this CINCINNATI Precision Production Line. Rods are hardened and ground at the rate of 960 per hour. Hardened and ground diameter is indicated by heavy red line in above drawings.



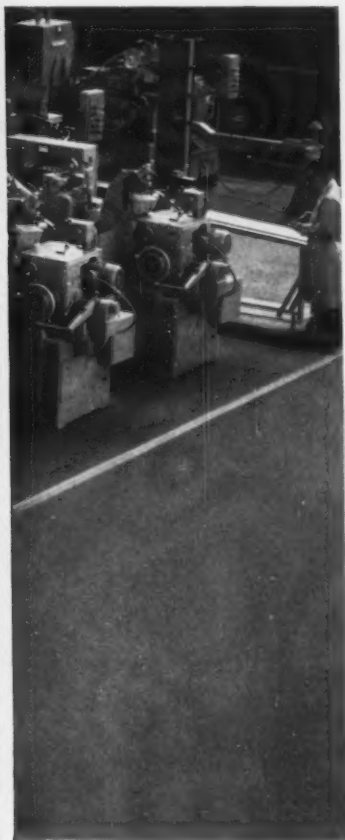
CINCINNATI INDUCTRON Induction Heating Machine shares the spotlight with five CINCINNATI FILMATIC Centerless Grinders.

BUILDERS OF PRECISION GRINDING MACHINES: CENTERTYPE • CENTERLESS • MICRO-CENTRIC
THE CINCINNATI MILLING MACHINE CO., CINCINNATI 9, OHIO

hardened and ground on ...



CINCINNATI Precision Production Line!



Shortest and fastest trip to the point of perfection . . . the one taken by shock absorber piston rods in this CINCINNATI Precision Production Line. From the loading unit at the extreme left, work traverses first through a CINCINNATI FILMATIC Centerless Grinder for the primary grinding operation, then through an INDUCTRON® Induction Heating Machine for hardening of the center section. Four more Centerless Grinders complete the grinding operation, the finished parts emerging at a rate of 12 linear feet per minute or 960 per hour.

CINCINNATI FILMATIC Centerless Grinders are ideal for production line duty. FILMATIC grinding wheel spindle bearings never wear out or require adjustment. Infinitely variable regulating wheel speeds permit close adjustment of speed to suit station-to-station work traverse. Simple swivel plate adjustment aligns work rest and regulating wheel unit with conveyor. Unobstructed access at rear of machine facilitates setup and corrective adjustments. Many other feature-advantages are outlined in attractive literature.

Cincinnati Milling offers many types of products to give you unmatched completeness of production equipment. May we hear from you?

◀ Nine sizes of CINCINNATI FILMATIC Centerless Grinding Machines give you a choice of the right size for your work. Catalog G-727-1-D covers the Centuramic line.



ROLL • CHUCKING • CENTERLESS LAPPING

CINCINNATI®
GRINDING MACHINE DIVISION

A new concept for cutting grinding costs

RELIABLE

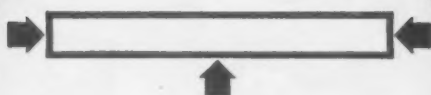
QUALITY

PRODUCTION

Exclusive Landis features
that assure reliable —

- | | |
|------------------|-------------------|
| 1. Work Support | 3. Wheelfeed |
| 2. Wheel Support | 4. Wheel Dressing |

To meet today's requirements for tolerances in millionths, consistently on mass produced parts, the new Landis plain cylindrical grinders were designed with features to improve all the factors that affect grinding output. This assures you reliable quality production.



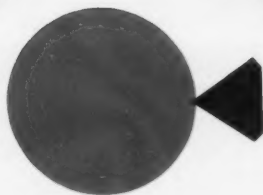
1. Work Support—Exclusive wedge work rest and loaded ball spindle foot-stock assure maximum rigidity to work.



2. Wheel Support—The exclusive Micro-sphere bearing reduces sparkout time, speeds production.



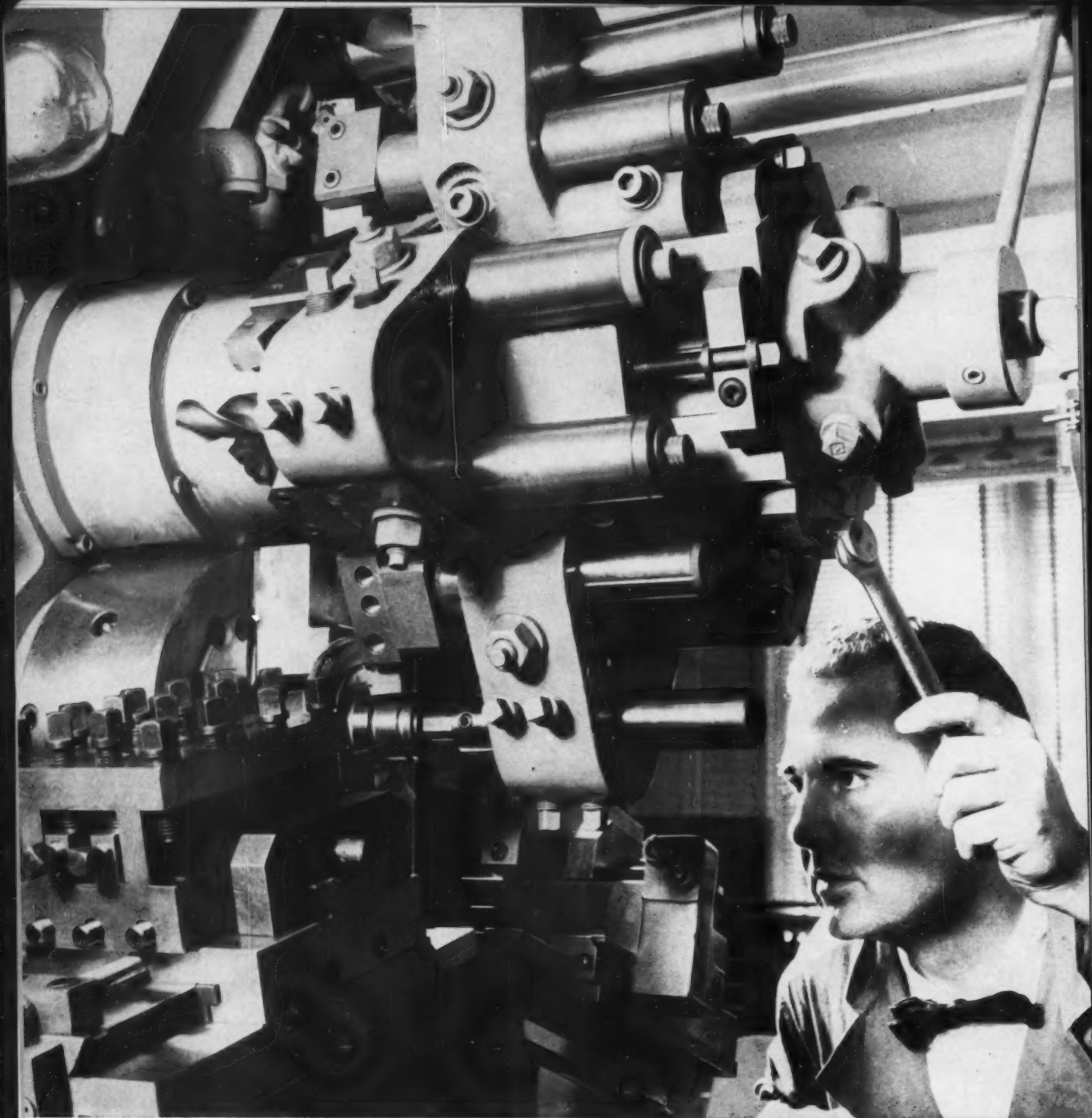
3. Wheelfeed—Exclusive Microfeed® a pulse feed in millionths to final size meets your tolerances on a production basis.



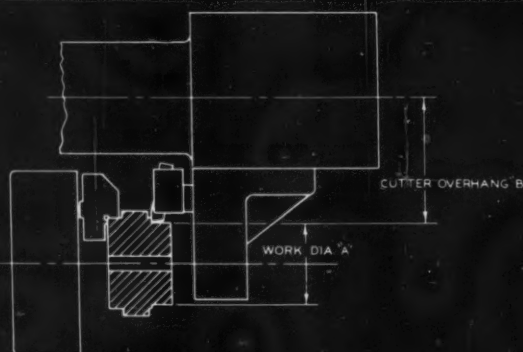
4. Wheel Dressing—Exclusive Truform dresser with shake-free construction assures exact reproduction of all wheel profiles.

LANDIS

LANDIS TOOL COMPANY, WAYNESBORO, PA.

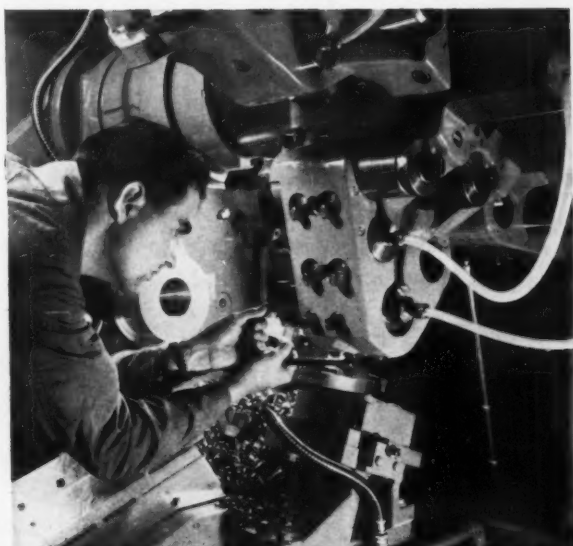


The overhead design of the multiple turning head allows extra heavy turning cuts. Note that as work diameter "A" increases, and the cutting torque thus increases, that cutter overhang "B" decreases. As a result, torsional forces which cause deflection of cutter supporting elements also decrease. The larger the work turned on an "AC"—the greater the rigidity of the tool support.





Warner & Swasey Chuckers let you snug-up the tools for maximum rigidity



The operator secures minimum tool overhang by adjusting cutter holders to suit their respective lengths of cut, after he has clamped the multiple turning head as close to the work as the longest cut permits.

W&S Single Spindle Automatics are designed to operate with minimum tool overhang. This promotes good finish, preserves sharp cutter edges, permits extra-heavy turning cuts.

An "AC's" open tool area means more than easy access; it provides clearance between multiple turning heads and the cross slides. Thus, during setup, multiple turning heads can be shoved forward along the pentagon as close to the work as the longest cut permits.

Tool holders, clamped in through-holes in the turning heads, then project forward only the distance needed to position the cutters. Notice in the large photograph how the shanks protrude through the rear of the turning heads.

Result: minimum tool overhang and maximum rigidity.

"AC" rigidity is an advantage with a pay-off. It's just one reason to consider adding "AC's" to your shop. The Field Engineer will gladly give you the details. Or write The Warner & Swasey Company, Cleveland 3, Ohio.

YOU CAN TURN IT BETTER, FASTER,
FOR LESS...WITH A WARNER & SWASEY



BULLARD

THE PRICE IS LOWER !
THE **PRICE** IS LOWER !
THE PRICE **IS** LOWER !
THE PRICE IS **LOWER** !



with the NEW Bullard Mult-Au-Matic Type "M"

To achieve the same production output obtainable from a Bullard Mult-Au-Matic, Type "M", competitive methods would require a greater investment of capital funds.

Built to exacting Bullard standards, the Type "M", available with 6, 8, or 12 spindles, incorporates in its design many features which insure its rigidity, accuracy, and productivity, even on difficult machining jobs.

For complete Mult-Au-Matic, Type "M" information, write for a catalog or call your nearest Bullard Sales Office or Distributor.

The Bullard Company, Bridgeport 9, Conn.

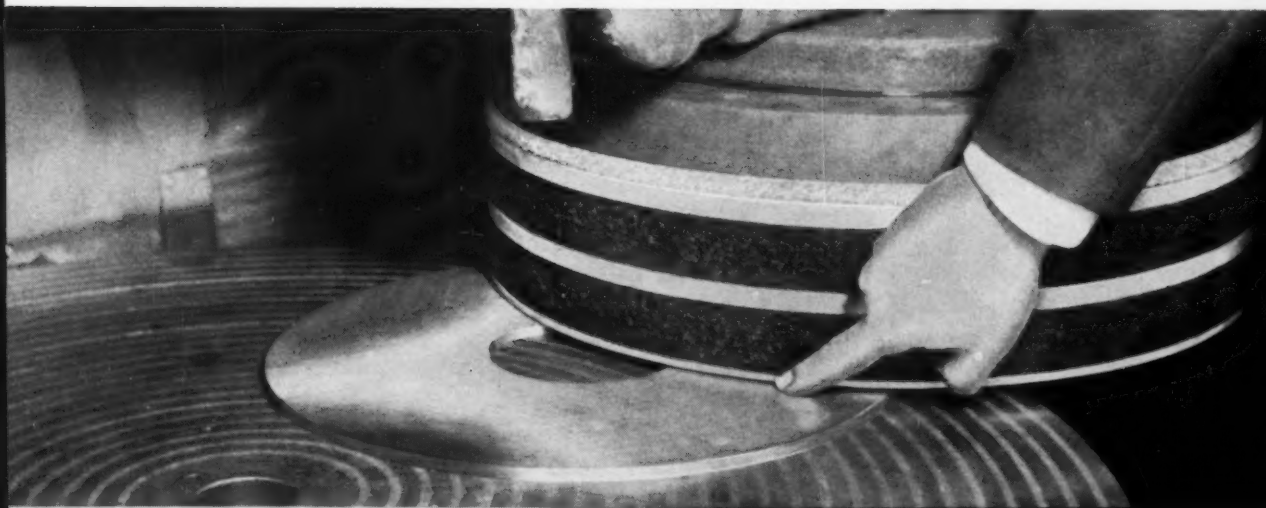
THE PRICE IS LOWER !

GARDNER TAPE BOUND WHEELS ELIMINATE DOWN TIME

Glass fibre tapes remain on wheel until ground away . . . no production stoppages for cutting and removal



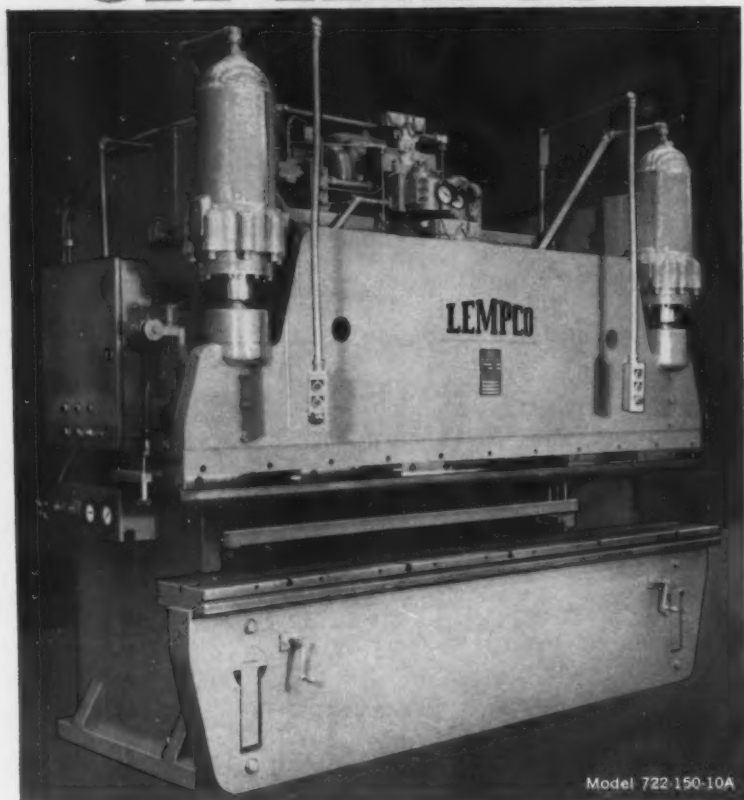
Gardner tape bound wheels now provide continuous, uninterrupted production by eliminating the need for costly stoppages to cut and remove wire binding.



GARDNER

GARDNER MACHINE COMPANY, BELOIT, WISC.

SEE LEMPCO...



Model 722-150-10A

A Lempco hydraulic press brake is a production man's machine tool. Simple, rugged and accurate. Designed to put and hold the profit factor in the general run of shop work.

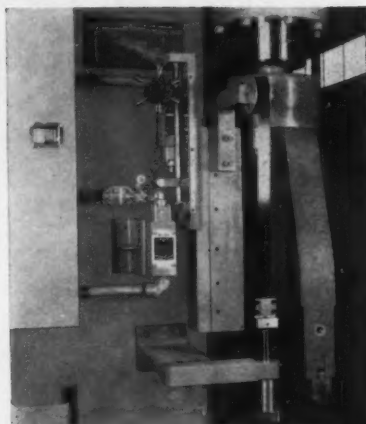
Offered in standard models of 75 tons capacity and upward, Series 722 hydraulic brakes are powered by the exclusive Lempco equalizing drive. No destructive shock surges, no fussy electronics. Just a good smooth and simple power drive with manifolded valving and a minimum of component parts. Frames are heavy rolled steel plate, sized to a standard of minimal deflection.

A wide line of standard and optional control features enables you to put the precision into your work that good commercial practice requires.

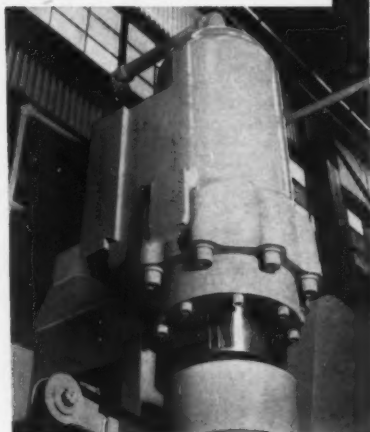
For more information call your local Lempco Machine Tool Division representative, or get in touch directly with the factory.

LEMPCO

MACHINE TOOL DIVISION
BEDFORD, OHIO



Stroke controls offer micrometer-precise depth stopping, adjustable limiting of ram return and slow-down to press.



Cast steel cylinders are dovetailed to the housings to hold accurate alignment under load.



Accurate, adjustable ram ways have bronze liners sliding smoothly against gibs bolted to the housings.

..."engineered-for-the-customer" products from the Lempco family of industrial equipment

LECTRA-FORM

Increases Production 500%

**Ex-Cell-O Model 244 machines recess
5 times faster, with far lower tool cost!**

Ex-Cell-O LECTRA-FORM Machines remove metal through high-current, low-voltage electrical spark discharge. Producing an inverse image of low-cost shaped rod, tubing or sheet metal tooling, LECTRA-FORM accurately drills, pierces, trepans, slots, cuts or sinks intricate cavities in carbides and other conductive materials difficult or costly to machine by other methods.

Contact your Ex-Cell-O Representative for details, or write for LECTRA-FORM Bulletin 436014.



Model 244 has an electro-hydraulic servo for automatic tool feed and gap control, removes metal without distortion due to tool pressure. Inset photo shows part before and after 8-minute LECTRA-FORM machining.

HERE'S HOW LECTRA-FORM COMPARES TO CONVENTIONAL MACHINING

WORKPIECE Nickel-alloy aircraft part*	LECTRA-FORM MACHINING	FORMER METHOD
Tooling	Low-cost brass rod	Small end-mill cutter
Tool cost	Negligible	High wear and breakage
Accuracy	Uniform wall thickness	Distorted wall contour
Machining time	8 minutes	40 minutes

*Depth of recess approx. .080", wall thickness approx. 1/32".

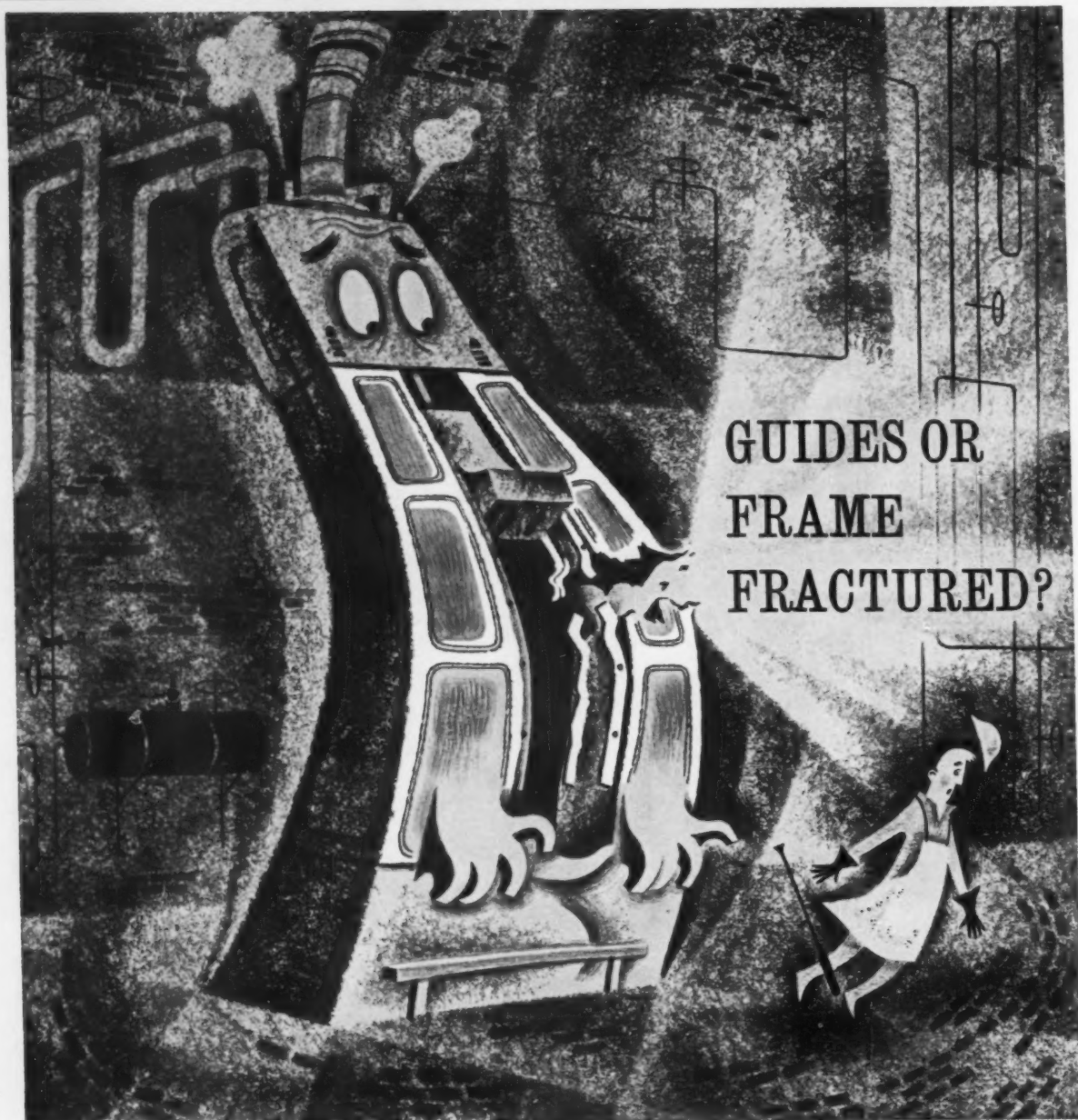
EX-CELL-O FOR PRECISION

PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL DIE BUSHINGS • JIG AND FIXTURE COMPONENTS • TORQUE ACTUATORS • CONTOUR PROJECTORS • GAGES AND GAGING EQUIPMENT • GRANITE SURFACE PLATES • COMPUTER PRODUCTS • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • ATOMIC ENERGY EQUIPMENT • DAIRY AND OTHER PACKAGING EQUIPMENT

Machinery Division

EX-CELL-O
CORPORATION
DETROIT 32, MICHIGAN

61-30M



GUIDES OR
FRAME
FRACTURED?

Call ERIE FOUNDRY for forging hammer replacement parts

Replacement guides, frames, and other parts for a wide variety of forging hammers of most any make are available from ERIE. They are high in quality, competitive in price.

For over 65 years we have specialized in the design, development and manufacture of forging hammers of all types. Logically, then, Erie Foundry is a natural source for repair parts equal in quality and performance to the original equipment. Substantial inventories assure you of prompt service. For more information on repair parts or our complete Hammer Rebuilding Service, write Mr. James Walker.

Manufacturers of Forging Hammers • Forging Presses • Hydraulic Presses • Trimming Presses

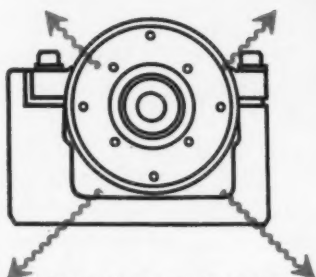


ONE OF THE GREAT NAMES
IN FORGING SINCE 1895

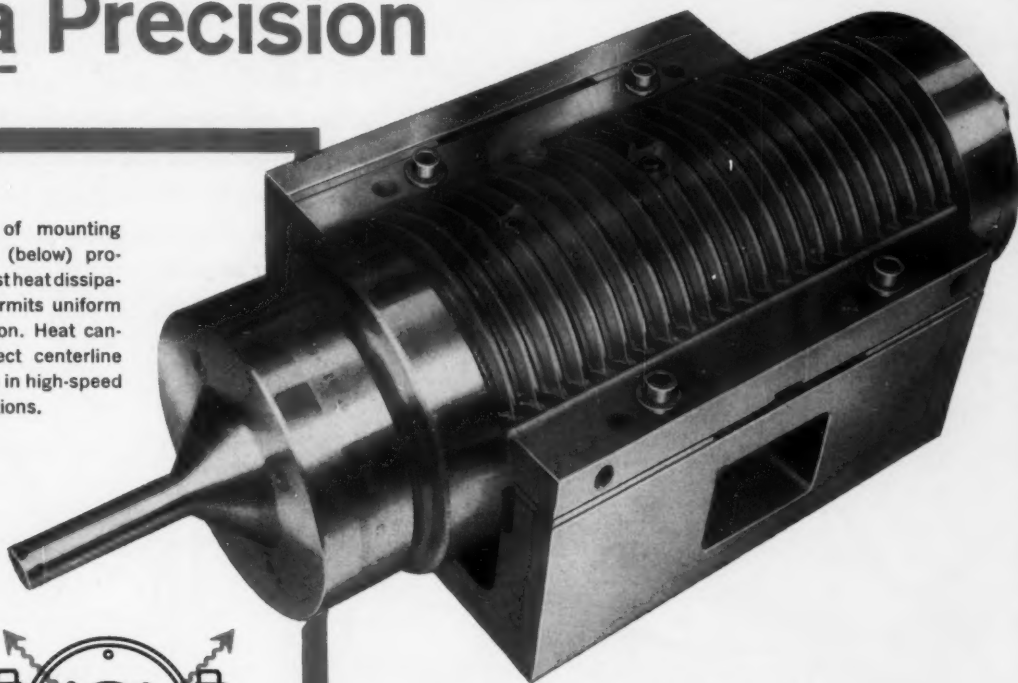
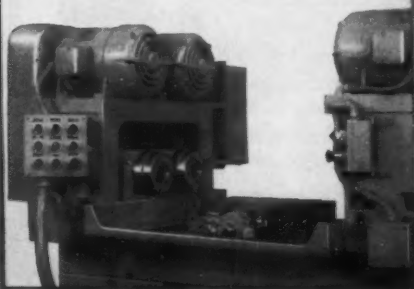
ERIE FOUNDRY CO., Erie, Pa.

NEW Ex-Cell-O Spindles for Ultra Precision

Design of mounting bracket (below) provides fast heat dissipation, permits uniform expansion. Heat cannot affect centerline position in high-speed applications.



Below: This standard double-end Ex-Cell-O Precision Boring Machine provides a steady platform for the ultra-precision boring job described at right.



The special spindle shown above is one of 16 identical Ex-Cell-O Ultra Precision Boring Spindles recently developed for an extremely demanding boring operation.

Customer specifications called for a guaranteed maximum allowable .00003" on roundness, with a 10 RMS or better surface finish. The spindles Ex-Cell-O delivered have consistently held .00002" on roundness, with a 6 micro-inch surface finish (and the customer has ordered duplicates)!

Why do the new Ultra Precision Spindles and other standard and special Ex-Cell-O Boring and Grinding Spindles give consistently greater accuracy, finer finishes and longer, trouble-free life?

The answers are: Engineering and production experience (more than 40 years); exclusive design and construction (using famous Ex-Cell-O Spindle Bearings); and job-tailored availability (Ex-Cell-O offers the most comprehensive line of belt-driven, air-driven, motorized and high-frequency spindles available today).

Need fast delivery of Precision Spindles for original equipment or replacement use? Call your Ex-Cell-O Representative today, or contact Ex-Cell-O in Detroit.

60-85

EX-CELL-O FOR PRECISION

PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • JIG AND FIXTURE COMPONENTS • TORQUE ACTUATORS • CONTOUR PROJECTORS • GAGES AND GAGING EQUIPMENT • GRANITE SURFACE PLATES • COMPUTER PRODUCTS • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • ATOMIC ENERGY EQUIPMENT • DAIRY AND OTHER PACKAGING EQUIPMENT

Machinery Division

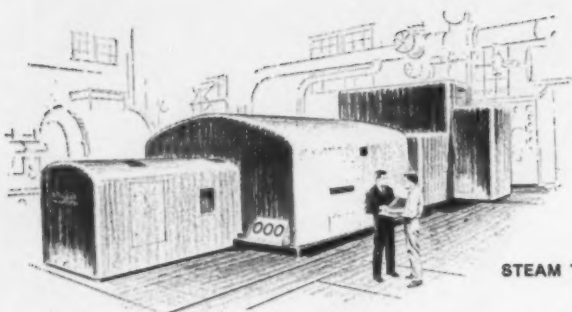
EX-CELL-O
CORPORATION
DETROIT 25, MICHIGAN

DE LAVAL

**engineered
dependability
has helped
keep America strong for
60 years**

Since 1901, De Laval has helped keep America strong by supplying high-quality, precision-built equipment to almost every industry and service. In refineries . . . power plants . . . steel mills . . . mines . . . waterworks . . . pipelines . . . paper mills . . . the armed forces and the merchant marine, De Laval's engineered dependability has helped strengthen our country's economy and defenses for 60 years.

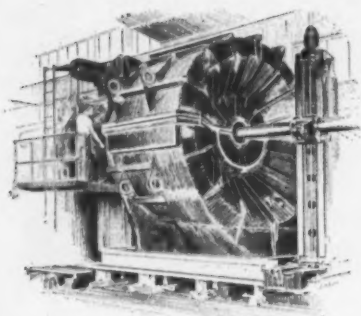
De Laval Steam Turbine Company, Trenton 2, N. J.



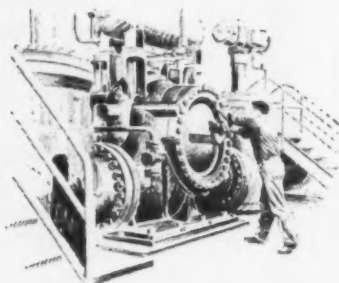
STEAM TURBINES



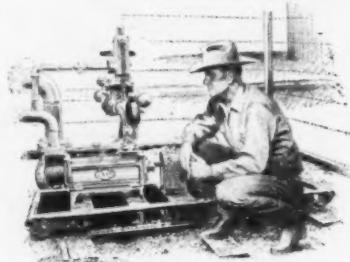
CENTRIFUGAL PUMPS



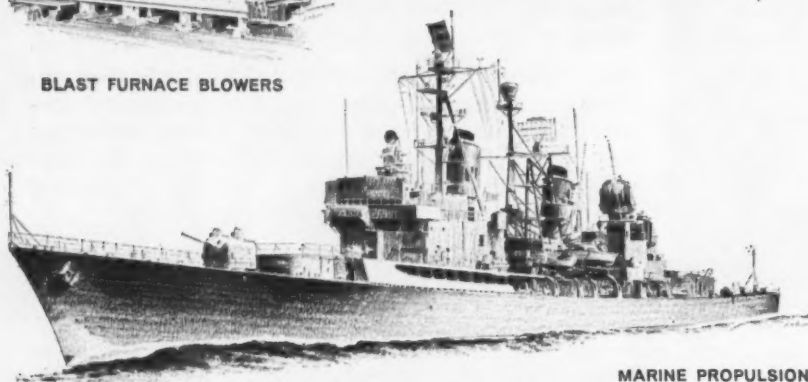
BLAST FURNACE BLOWERS



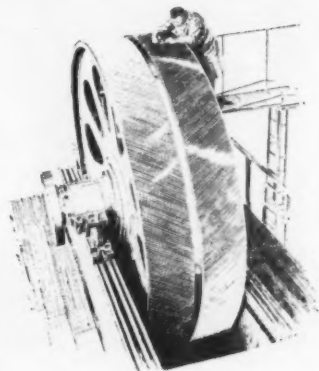
SINGLE- AND MULTI-STAGE COMPRESSORS



IMO® ROTARY PUMPS



MARINE PROPULSION UNITS AND AUXILIARIES



DE LAVAL • 60 YEARS OF CREATIVITY AND QUALITY

CENTRIFUGAL PUMPS AND COMPRESSORS • TURBINES • IMO® ROTARY PUMPS AND HYDRAULIC MOTORS
MARINE PROPULSION AND AUXILIARY EQUIPMENT • HELICAL AND EPICYCLIC GEARS • TURBOCHARGERS

MG-DL-112

Quality Controlled at Every Step!

Production parts bored, counterbored, spot-faced, milled, drilled, hardened and ground to your precise specifications

Check an Ex-Cell-O process sheet on any Ex-Cell-O precision production part, and you'll find that at every step, quality control is an important part of Ex-Cell-O Ability.

Ex-Cell-O metallurgical laboratories test each run of stock and maintain a close watch on heat treatment methods and results. Non-destructive testing closely follows many Ex-Cell-O machining processes, and production inspection stations use the most modern equipment available.

If precision parts and assemblies are important to your product, your local Ex-Cell-O Representative has a quality control story that will be of interest to you. Call him soon, or simply send us your prints or requirements for a prompt quotation.



These precision parts are produced in volume, yet they are quality-controlled to custom work standards. Large photo above shows typical inspection equipment—a 30-inch Ex-Cell-O Contour Projector used to inspect parts at 100X magnification.



EX-CELL-O FOR PRECISION

PRECISION MACHINE TOOLS • GRINDING AND BURNING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • JIG AND FIXTURE COMPONENTS • TORQUE ACTUATORS • CONTOUR PROJECTORS • GAGES AND GAGING EQUIPMENT • GRANITE SURFACE PLATES • COMPUTER PRODUCTS • AIRCRAFT AND MISCELLANEOUS PRODUCTS • PARTS • ATOMIC ENERGY EQUIPMENT • DAIRY AND OTHER PACKAGING EQUIPMENT

Precision Parts Division

EX-CELL-O
CORPORATION
DETROIT 32, MICHIGAN

**Sees
Increased Sales,
Lower Profits**

Its midyear report confirms [redacted] Company's prediction for the current fiscal year. Despite increased sales volume, profits have been substantially lower than expected.

**Rising Costs Cut
Profits, [redacted]
Reports**

[redacted] Company's 1st half operations showed a drop in profits, according to the Company's president. Increases in the cost of several basic manufacturing items accounted for a good portion of this tapering of profits.

**[redacted] Reports 2nd
Quarter Drop**

[redacted] Manufacturing reports its 2nd quarter showed a drop in net profits. A spokesman reported that this condition arose despite slight increase in sales.

**COSTS
UP?
PROFITS
DOWN?**

Try

NICE

for **Performance and Price**

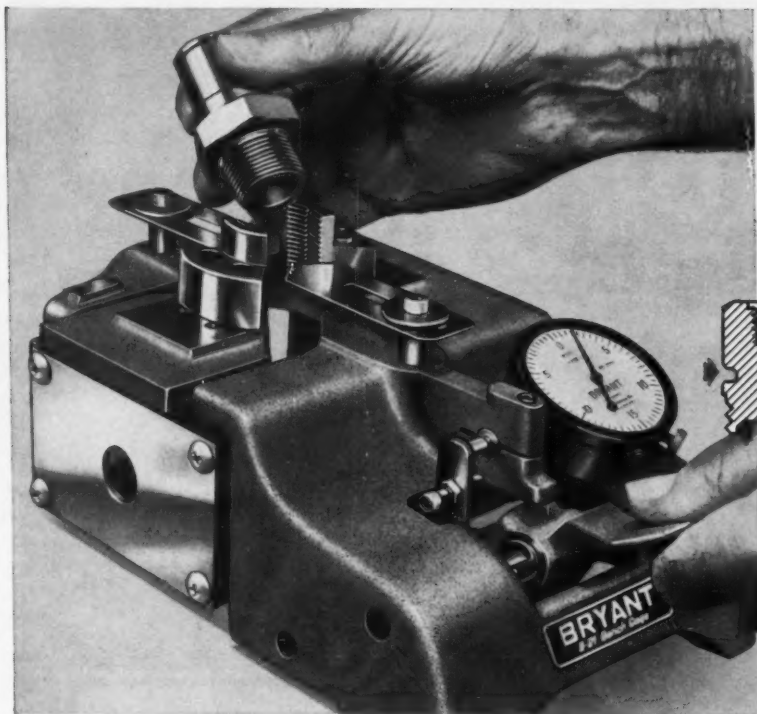
Cost-conscious manufacturers will find many cost-saving advantages offered by NICE Ball Bearings. NICE can provide a complete range of standard or custom designed unground, semi-precision and precision bearings—and Product Designers can select bearings that insure a properly functioning product, yet one that is economically produced and competitively priced.

When cost is a problem... yet quality is a MUST... try NICE, for Performance and Price.



NICE BALL BEARING COMPANY
NICETOWN · PHILADELPHIA · PENNSYLVANIA

All these checks . . . with one Bryant Gage!



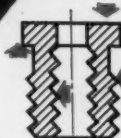
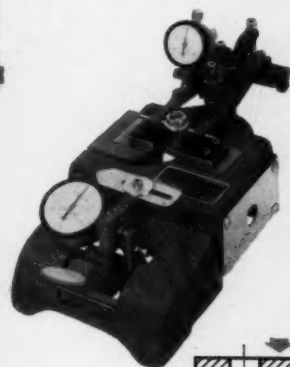
CHECKS THREADS, GROOVES AND BORES —Bryant B-21 Bench Gage checks parts with special grooves, snap-ring or O-ring grooves, or ID and OD threads in all classes to 5" diameter—and does it 8 to 10 times faster than other methods! Stationary and movable gaging segments end the need to thread parts onto gage.

CHECKS SQUARENESS-OF-FACE —With optional Squareness-of-Face Attachment, the B-21 simultaneously checks thread size and true face run-out in relation to thread axis. Two models: One for parts up to 2" face diameter, one for parts to 7" face diameter. Attaches in seconds to the B-21 Gage.

CHECKS ID CONCENTRICITY —Attachment A-9100-B quickly converts the B-21 to check concentricity of bores, grooves or special internal recesses in relation to OD threads or plain OD surfaces of parts up to 8" diameter with up to 5" nominal thread size.

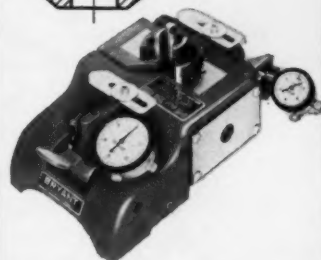
AND MORE —See your Bryant Gage Representative, or write for prices, engineering data, and bulletins on the standard and special accessories that make the Bryant B-21 Bench Gage indispensable to quality control throughout industry.

STANDARD B-21 GAGE



SQUARENESS-OF-FACE

I. D. CONCENTRICITY

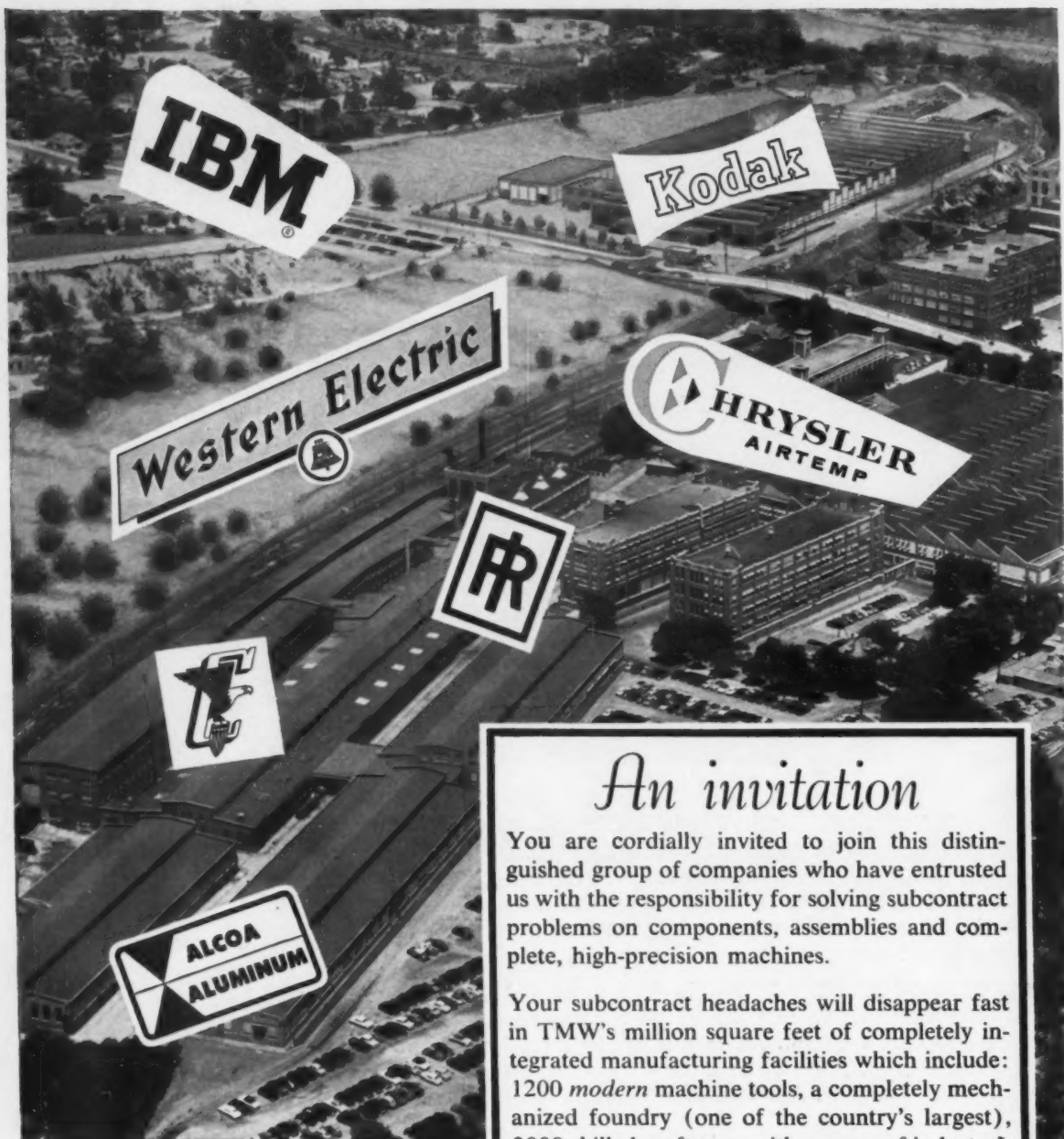


EX-CELL-O FOR PRECISION

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EX-CELL-O
CORPORATION

Greenville Plant, 945 E. Sater St., Greenville, Ohio



An invitation

You are cordially invited to join this distinguished group of companies who have entrusted us with the responsibility for solving subcontract problems on components, assemblies and complete, high-precision machines.

Your subcontract headaches will disappear fast in TMW's million square feet of completely integrated manufacturing facilities which include: 1200 modern machine tools, a completely mechanized foundry (one of the country's largest), 3000 skilled craftsmen with a corps of industry's top designers and engineers.

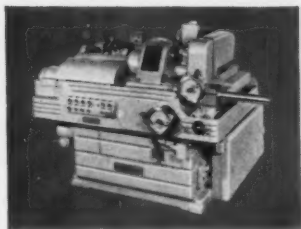
TMW's facilities and 65 years' experience in precision (tolerance to 10ths) manufacturing is available to you *now*, on a short or long-term basis. For more details, or for new Facilities File Folder, call or write: Textile Machine Works, Contract Division, Reading, Penna.



TEXTILE MACHINE WORKS
CONTRACT DIVISION • Reading, Pennsylvania

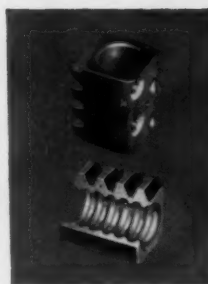
THREAD GRINDING COSTS TOO HIGH?

Here's How a Modern Ex-Cell-O can Increase Production and Lower Your Labor Costs

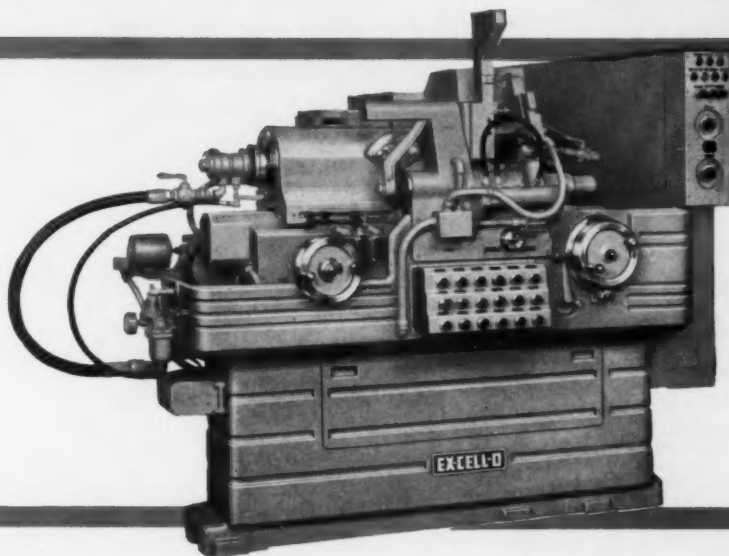


1939—Style 39 Ex-Cell-O Internal Thread Grinder, then the fastest of its kind, produced 17 automotive steering gear ball races per hour. It had power wheel dresser, automatic dresser compensation and automatic wheel feed.

1946—The part's the same, but the manufacturer has turned to a postwar Ex-Cell-O Style 39-A Precision Thread Grinder with fully automatic grinding cycle, including automatic wheel dressing at predetermined intervals. Operator simply loaded the part, reset the size handwheel and pressed the start button. Production increased to 24 parts per hour.



1960—Modern Style 39-A, today produces the same basic part but now at a rate of nearly 60 parts per hour. This powerful, versatile machine has a high-speed workhead, high-frequency Bryant Grinding Spindle, automatic loading, unloading and cycling. It requires only the part-time attention of one unskilled operator.



TOMORROW—Will you have a similar long-run part, or perhaps pinions, worms, taps, thread gages, lead screws, missile components or other special parts that cannot be rough- or finish-ground economically on your present equipment?

Your local Ex-Cell-O Representative can show

you how modern Ex-Cell-O Precision Thread Grinders can substantially reduce the cost of producing a wide variety of your large and small threaded parts. Call him today, or write direct for details on the complete line of Ex-Cell-O Internal, External and Universal Thread Grinders for every toolroom and production job.

40-35

EX-CELL-O FOR PRECISION

PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • JIG AND FIXTURE COMPONENTS • TORQUE ACTUATORS • CONTOUR PROJECTORS • GAGES AND GAGING EQUIPMENT • GRANITE SURFACE PLATES • COMPUTER PRODUCTS • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • ATOMIC ENERGY EQUIPMENT • DAIRY AND OTHER PACKAGING EQUIPMENT

Machinery Division

EX-CELL-O
CORPORATION
DETROIT 35, MICHIGAN

BOSTON *gear* **QUALITY**

time-proved REDUCTOR® and RATIOMOTOR® reliability
largest selection for worm-gear drives from stock



Horizontal or vertical, right angle or parallel, single or double reduction.

Reducers - for .10 to 15 HP drives - ratios 1:1 to 3600:1.

Ratiomotors - .035 to 10 HP - output torque 4 to 9400 in. lbs.

Detachable motor design. Motor can be changed in minutes.

Ratiomotors sold also without motors as **Flanged Reducers**.

1605 stock sizes, types, ratios. See Catalog 57 for complete listings.

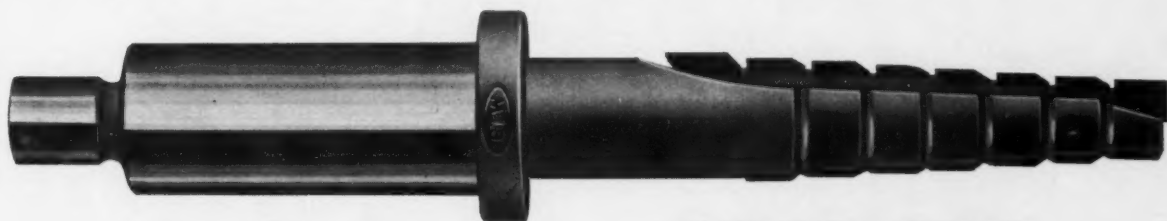
IN STOCK at your nearby DISTRIBUTOR

BOSTON *gear* [®]

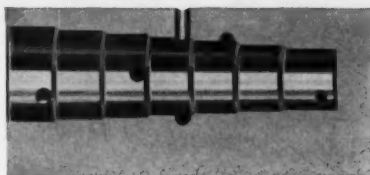


© Boston Gear Works, 1961
Quincy 71, Mass.

Seven Diameters . . . from solid to finish with one tool, one pass!

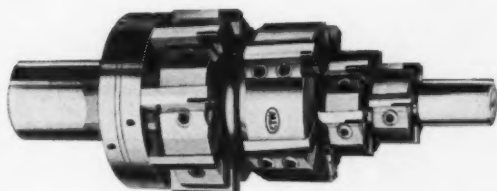


Special CTW Bor-Reamer bores and chamfers seven diameters from solid to finish in one operation. Tool is carbide-tipped, uses carbide bearing pads to maintain .001" tolerance on bore size and concentricity. Cut-away photo at right shows ID detail of non-ferrous aircraft part.



Imagine the setup and machining time you might save with a single Continental Special Cutting Tool custom-designed to combine two or more operations, to take multiple cuts, or to mill complex contours! Why not let CTW combine your operations

on production or short-run jobs? A call to your local CTW Representative will immediately put 40 years of cutting tool research, engineering and manufacturing experience to work for you. Call him today, or write direct for details.



Inserted-blade special cutter, left, finishes four diameters and four shoulders in one pass. Tungsten carbide-tipped cutter at right combines two-step boring, hollow milling and plunge-facing in one tool.



DESIGN FEATURES TESTED IN EX-CELL-O'S OWN MANUFACTURING PLANTS . . .
PRODUCTION-PROVED IN CUSTOMERS' PLANTS THROUGHOUT THE WORLD!



TOOL WORKS
DIVISION OF

CTW

EX-CELL-O
CORPORATION
DETROIT 32, MICHIGAN

61-34C

NIKON OPTICAL COMPARATOR

new model 3A offers unusual screen brightness and image resolution — features zoom-condenser system

The unusual image brightness, definition and accuracy achieved in the new model 3A—to the very edge of the screen—is a credit to the quality and design of its optical system.

The new Nikon model 3A permits surface as well as contour inspection—independently or simultaneously. And controls are provided for adjusting the intensity of each of the illuminators.

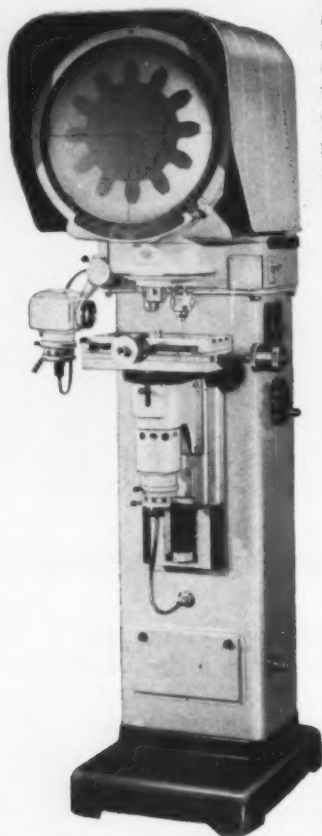
The surface illuminator may be used obliquely to emphasize surface texture. Or, for greater measurement accuracy, the surface illuminator may be used in conjunction with lens-mounted, half-reflecting 45° angle mirrors to provide shadowless light on the optical axis. Contour illuminator employs a special zoom condenser matching system. Convenient control simplifies adjustment for optimum illumination at each magnification.

Model 3A is normally supplied with a choice of one or more standard lenses in magnifications ranging from 10x to 100x. Other magnifications are also available on special order. A 3-lens turret supplied as standard equipment, facilitates instant changes. Focusing is smooth and effortless. Utilizes leadscrew drive with scraped ways and adjustable gibs.

The model 3A is equipped with a sliding hood which may be drawn out to shade the screen, or can be retracted to permit ready access to chart or screen surface. The overall diameter of the screen glass is 14½", designed for use with standard charts.

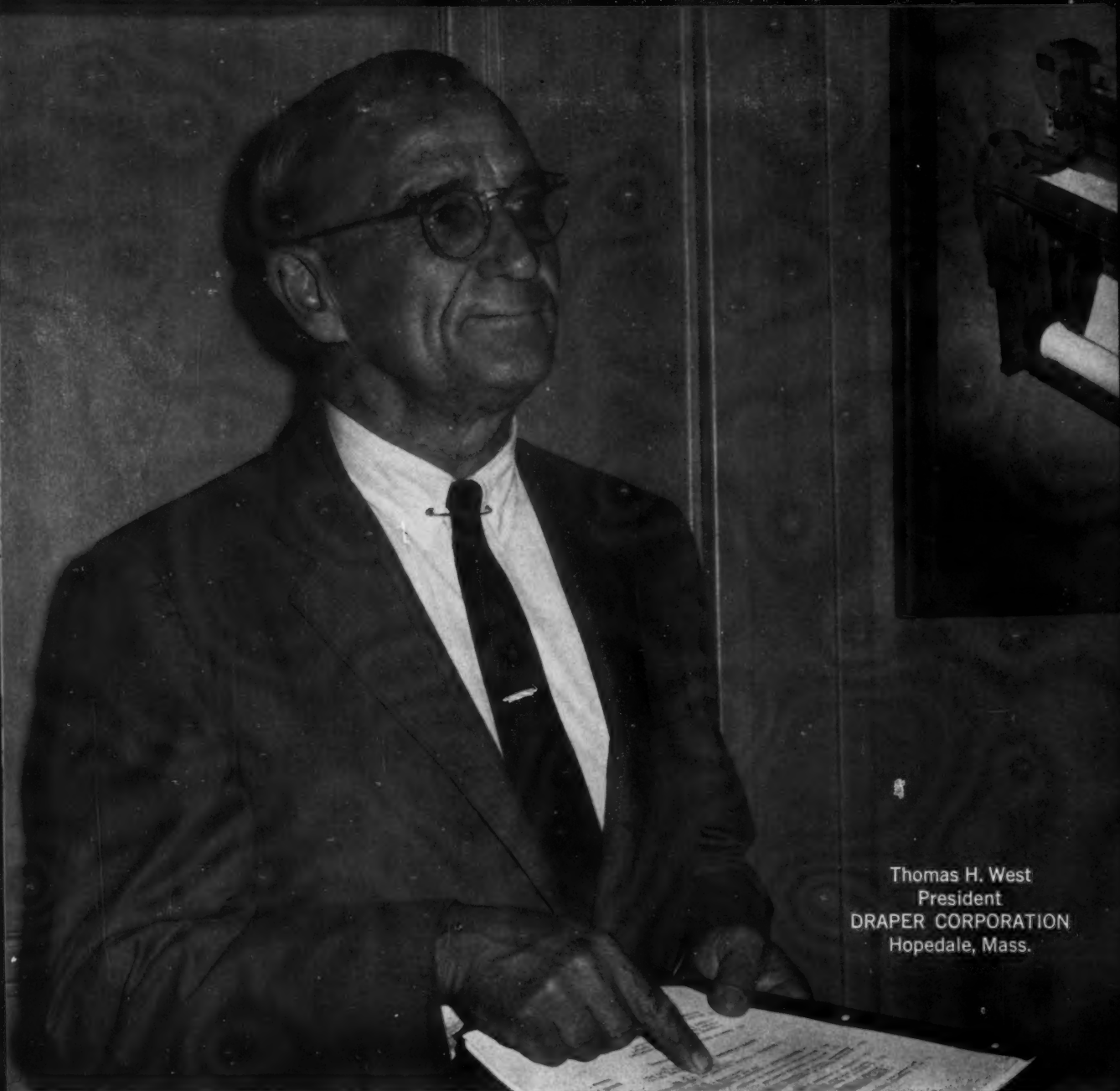
The new Nikon 3A accepts a wide variety of micrometer stages, holding fixtures, protractor screens, charts, photo attachments, and other accessories. For details write to Dept. M-10.

features
new 14"
screen



NIKON INCORPORATED Instrument Division 111 Fifth Avenue New York 3, N. Y.

Makers of optical inspection instruments, scientific and industrial microscopes, surveying instruments, cameras, telescopes, binoculars and other precision optical equipment.



Thomas H. West
President
DRAPER CORPORATION
Hopedale, Mass.

"THE MACHINE TOOL GAP... a danger to the nation...and to industry"

"We've heard a lot about the missile gap. Some agree it exists — some disagree. But it certainly appears there *is* a 'machine tool gap'.

"Neglecting to replace obsolete production equipment is a hazard we can no longer afford. It is dangerous to the nation because it threatens our very survival in the cold war. It handicaps

the individual manufacturer because a strong competitive position cannot be maintained without the most efficient equipment available.

"At DRAPER CORPORATION, our machine tool budget is planned to keep us well prepared to meet this constant challenge."

This statement reprinted courtesy of Draper Corporation

Brown & Sharpe

Close the
MACHINE
TOOL GAP

MODERNIZE MILLING AND MAKE MORE FOR LESS



New B&S RANGEMASTER® provides biggest work capacity in its class... saves extra cost of bigger machine

The new Brown & Sharpe RANGEMASTER has the largest working area ever offered in a No. 2 size milling machine table. You can mill all around pieces that would normally require a No. 3 size or larger machine, like the big plastic mold shown, without changing the set-up. Table travel up to 34" * is available, and transverse feed up to 12".

You can mill deep down inside, also. The vertical spindle can be centered up to 25" away from the face of the column. It has a compound swivel and 3½" axial feed. You save on set-up time, and on tooling costs, since both spindles have the same standard taper.

With the many new B&S DYNAMASTER design features, the RANGEMASTER is now, more than ever, your best investment in a sliding head, "ram-type" milling machine — for toolroom, prototype, experimental, and maintenance jobs.

Ask for complete information on the No. 20 RANGEMASTER, 3 HP Universal or Plain. Write: Machine Tool Division, Brown & Sharpe Mfg. Co., Providence 1, R. I.

***70 SQ. IN. MORE WORKING AREA.** When specified, the RANGEMASTER can be furnished with table 60¾" long and 34" table travel — plus completely automatic climb milling engaged during feed only. The standard table is 54¾" long with 28" travel. The DYNAMASTER provides a wide range of feeds, and is also available with double the standard feed rate.

Brown & Sharpe  **PRECISION CENTER**

Close the
MACHINE
TOOL GAP

MODERNIZE GRINDING AND MAKE MORE FOR LESS



For "all around" sharpening at lower cost...
B&S No.10N and No.5 Cutter and Tool Grinding Machines

Both the No. 10N and the No. 5 Tool Grinders are 100% operative from any point in 360° of work area. This is just one of the many B&S design features that permit you to handle a bigger variety of sharpening jobs, with substantial time savings.

You get all the advantages of machines *designed by cutter specialists*. As a leading producer of cutting tools, Brown & Sharpe can fully anticipate your needs. Every feature required for the most intricate sharpening problems is available in machines and attachments. *You buy only what you need* for your operations.

Brown & Sharpe design provides wheel mounting at both

ends of the spindle. A cutter bar attachment *eliminates critical table setting* for peripheral sharpening. Wheel spindles mounted on pre-loaded, permanently sealed ball-bearings assure consistent high precision and fine finish.

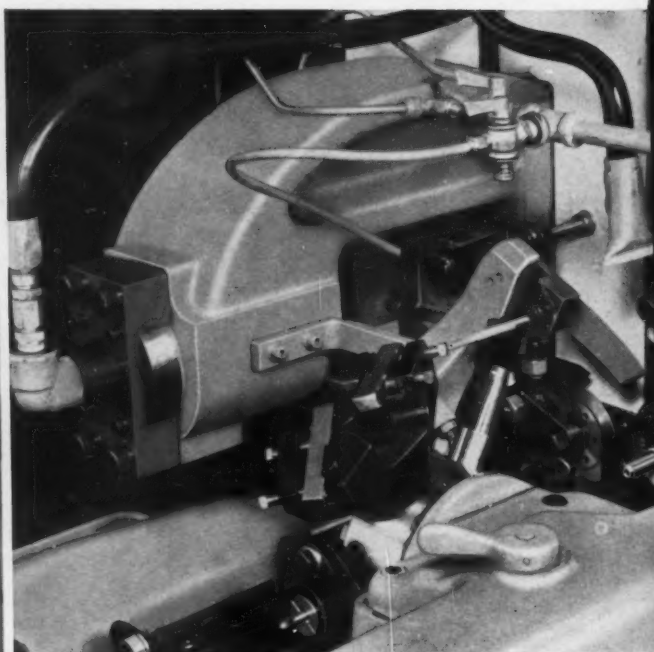
For full information, write: Machine Tool Division, Brown & Sharpe Mfg. Co., Providence 1, Rhode Island.

No. 10N (above), capacity 10" x 29", will handle all your sharpening jobs. With optional equipment, it can also be used for light external and internal cylindrical grinding and surface grinding. No. 5 has ample capacity, 6 3/4" x 17 1/2", for routine sharpening — takes less than 8 sq. ft. of floor space. Standard work head tapers fit all commonly used collets and adapters.

Brown & Sharpe  **PRECISION CENTER**

**Close the
MACHINE
TOOL GAP**

MODERNIZE SCREW MACHINING AND MAKE MORE FOR LESS



New B&S Broaching Attachment operates in "free" time while other machining proceeds at the spindle.

60% SAVING

With previous
equipment

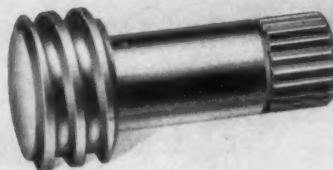
45*

sec. per piece

With B&S Automatic
and Broaching Att.

16

*includes time for secondary operation which is now eliminated, for drilling and tapping on hand machine.



New B&S Broaching Attachment helps reduce cost 60% for part now produced complete on No. 2 - $\frac{3}{4}$ " Automatic

The valve stem shown, made from $\frac{3}{4}$ " brass rod, requires turning, drilling, forming, threading, tapping, and broaching. All machining is completed in one cycle on a B&S No. 2- $\frac{3}{4}$ " Automatic equipped with a Broaching Attachment. The extra cost of a secondary operation on a separate hand screw machine, formerly required for drilling and tapping, is now eliminated.

The new B&S Broaching Attachment permits a further saving. Broaching is "free", since the operation is performed automatically by the attachment while the next piece is being machined at the spindle. Production time, formerly 45 sec.,

is now 16 sec. per piece — a saving of 60% in production cost over the previous method.

The new design B&S Automatics offer you comparable savings. You get extra adaptability for combined operations. Parts that normally require secondary operations for unusual slotting, milling, drilling, or tapping, as well as broaching, can now be machined complete from the bar.

The B&S No. 2 Automatic is available in 3 sizes — $\frac{3}{4}$ ", $1\frac{1}{4}$ ", and $1\frac{1}{2}$ " spindle capacity. For complete information write: Machine Tool Division, Brown & Sharpe Mfg. Co., Providence 1, Rhode Island.

Brown & Sharpe  **PRECISION CENTER**

Close the
MACHINE
TOOL GAP

MODERNIZE DRILLING AND MAKE MORE FOR LESS



B&S Turret Drilling cuts time from 32 to 10 minutes for machining 11 holes in case-hardened shaft

Drilling and tapping 11 bottom holes in a $1\frac{1}{2}$ " dia. case-hardened steel shaft took 32 minutes as previously performed on a single spindle machine. Slow manual setting was required to meet the 0.003" locating tolerance specified for each hole. Changing tools for the various operations further increased production time and costs.

The same job is now performed on a Brown & Sharpe Model B Turret Drilling Machine, and requires only 10 minutes per shaft. The rectangular B&S Positioning Table used accurately locates the work for each successive hole. No fixtures are required. Two shafts, held in standard vises mounted on the table, are machined in each set-up.

The six tools in the turret are indexed successively into accurate alignment with the machine spindle. The operations are: (1) penetrate case with $\frac{1}{2}$ " carbide drill, (2) spot drill $\frac{5}{16}$ " dia. $\frac{3}{32}$ " deep, (3) flatten bottom of hole with end mill, (4) center drill, (5) drill 0.265" dia. $1\frac{1}{32}$ " deep, (6) tap $\frac{5}{16}$ " x 18 to bottom.

B&S Turret Drilling permits multiple operations at a single station, with one set-up — accurate duplication of any hole pattern without expensive jigs. Find out how much it can save for you, in all types of production drilling and tapping. For complete information, write: Machine Tool Division, Brown & Sharpe Mfg. Co., Providence 1, Rhode Island.

Brown & Sharpe  **PRECISION CENTER**

MARLIN-ROCKWELL RELIABILITY COUNTS in SUPER-PRECISION bearings

MRC pioneered Super Precision Ball Bearings used by leading manufacturers of high speed machine tool spindles.

For the extreme accuracy and high speed performance required by modern machinery consult our Engineering Department.



MRC *Leadership*

Backed by 63 Years Experience

MARLIN-ROCKWELL CORPORATION

Jamestown, N. Y.

Production Pointers

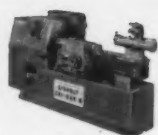
from

GISHOLT



More cost-cutting IDEAS—
to help you

MACHINE AND THREAD AUTOMATICALLY



**M-D Blowers, Inc. saves time,
space and cuts costs 70%**

How many chuckings would you need on your present equipment to machine and thread the port fitting on the cast iron internal pipe flange shown at right? M-D Blowers, Inc., Racine, Wis., did it in two . . . now they do it in *one* automatic operation on a CRI-DAN B!



The CRI-DAN Automatic Threading Lathe was designed primarily to cut top quality threads in minimum time using an inexpensive single-point carbide tool. Now, you can add accessories that combine threading with facing, turning, boring or tracing during the automatic cycle for extra savings.



A 5" flange in face plate fixture. Rear facing slide faces hub end and chamfers O.D. with automatic tool relief. Cross slide feed is disengaged while pusher is used to bore a $\frac{3}{8}$ " per foot taper for 1 $\frac{1}{4}$ " and chamfer the I.D. (pre-set boring bar in quick-change holder shown in foreground). Boring bar is replaced with threading tool and cross slide feed is engaged. An 8 TPI single-start 5.563" major diameter 60° pipe thread is generated in 16 automatic passes in 5.5 minutes f.t.f. Time on 4" flange is 3.5 minutes f.t.f.

Here is the extra equipment used to provide this flexibility for the pipe flanges—a face plate fixture; a facing slide; a facing tool block with automatic relief; a 'pusher' device for boring from the longitudinal slide (or turning for other parts); a dove-tail tool block for the threading cross slide that permits fast interchange of pre-set boring and threading tool holders. *Tapers do not require special equipment.* Shafts are handled with an air chuck, a tailstock and a retractable tool block for load-unload clearance. Production information is given in the photo caption.

If tooling is planned to utilize the full capacity of the basic machine, you can also handle a wide range of dissimilar parts. M-D Blowers, Inc., uses the CRI-DAN B to machine and thread four sizes of pipe flanges (times range from 3.5 to 5.5 minutes f.t.f.); to thread shaft ends on seven sizes of SAE 4140 steel rotor shafts and ductile iron rotor shaft assemblies similar to those shown below (lengths from 16.2" to 28.6"—times from .45 to .7 minutes f.t.f.); and to machine and thread a number of other parts. Time reductions alone averaged 70% on all parts handled in the first month of operation—further savings are expected as more experience is gained.

CRI-DAN B Automatic Threading Lathes can be used to machine and thread standard and problem parts. You can expect time reductions of 30-80%. Other benefits include fewer operations, lower tool costs, automatic cycle efficiency, and...no compromise on quality.

For information on CRI-Dan, circle No. 762.



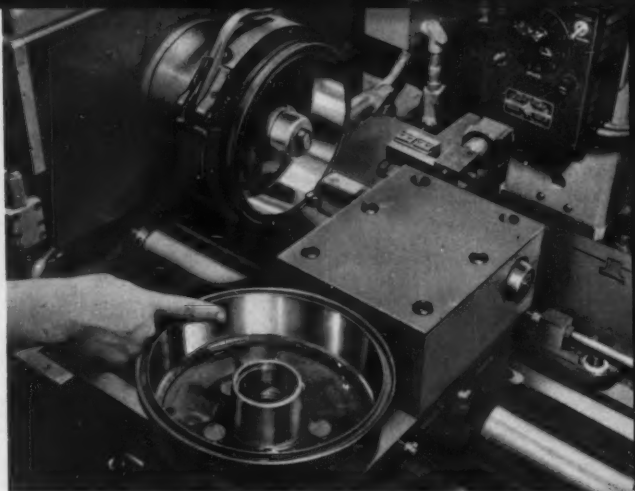
INEXPENSIVE SETUP DOES TWO JOBS IN ONE CHUCKING



No. 12 lathe machines and Superfinishes in one automatic operation

This "two-in-one" setup on the versatile Gisholt MASTER-LINE No. 12 Automatic Chucking Lathe may give you cost-cutting ideas for your work. Here, machining and Superfinishing is combined in a fast automatic cycle. Reduced handling and minimum equipment investment cuts costs. Accuracy is improved by completing work in one chucking.

The workpiece, a hub and brake drum assembly, is chucked through the small bore on an air-operated drawback fixture. A vibration dampener is clamped around the O.D. The I.D. is finish bored from the front carriage, which then tips toward the spindle centerline for tool relief before withdrawal. Next, a Gisholt Superfinishing Attachment—mounted on the rear independent slide—moves into position. The slide holds and the Superfinish stone feeds in to engage the bore. The I.D. is Superfinished from a bored surface to 25 micro-inches rms. Total f.t.f. time . . . only 1.5. minutes.

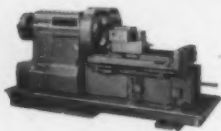


Cast iron hub and brake drum assembly is held in bore . . . finish bored and then Superfinished in fast, 1.5 minute f.t.f. automatic cycle. This kind of setup has wide application since it can be used for flat, tapered or cylindrical I.D. and O.D. surfaces.

Low-cost setup combines operations . . . saves time and work-handling . . . improves accuracy. Product is also improved because Superfinish exposes true base metal and increases braking area by removing jagged peaks left by machining. Smoother finish assures longer service life for mating brake shoes.

For more information on No. 12's, circle No. 763.

RING GEAR PRODUCTION PROBLEMS SOLVED THROUGH SPECIAL TOOLING



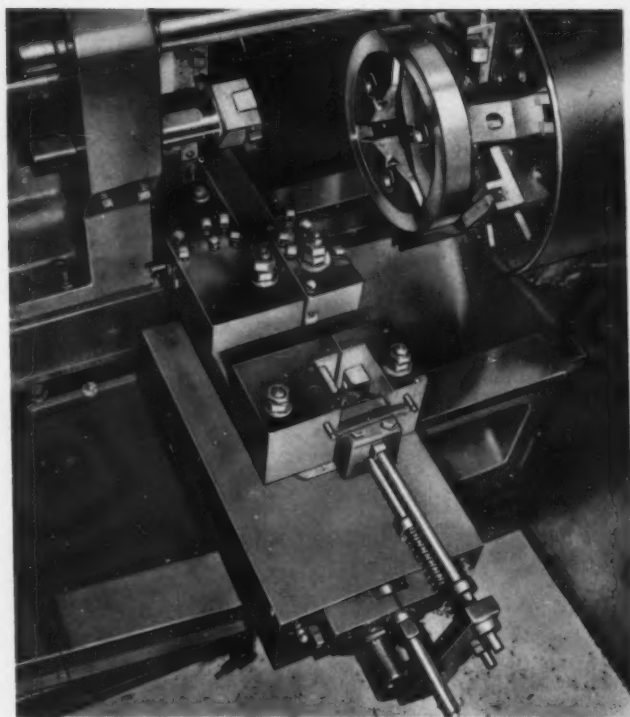
Alignment Concentricity and Fine Finish Simplified by Simplimatic Automatic Lathe

Maybe there's an idea for you in the way this manufacturer solved tough tooling problems with the right kind of setup.

The part, a steel final drive gear forging, had to have both front and rear faces perpendicular to the bore. Distortion through chucking pressures had to be absolute minimum. Location had to be accurate against dead stops, yet the back face had to be machined. No tool tracks could be left on front and back faces.

Every problem is licked through this smart tooling on a Gisholt Simplimatic: to equalize chucking pressures, avoid distortion and simplify alignment, swivel-type pie-shaped jaws chuck the work in the previously machined I.D. Maximum rigidity is assured through twin overhead pilot bars on a special boring head on the center slide. Clearance for straddle-facing and chamfering operations is provided by swinging jacks on the chuck face, which permit accurate location and swing out of the way. Tool tracks are eliminated by a special wedge-type tool relief arrangement on the rear slide. To bring the facing tools together, the wedge is engaged during the cut—then withdrawn to let the tool blocks spring apart for tool relief.

Floor-to-floor time? The job is completed in just 2.8 min.



Close-up of workpiece and tooling. Note wedge-type tool relief arrangement in rear slide.

Smart tooling plus the versatility of the Simplimatic eliminated many special problems in machining this final drive gear forging.

For information on Simplimatics, circle No. 764.

AR SAVES 60% ON SMALL PARTS FOR CULLIGAN, INC.

**Automatic cycle, combined operations
speed machining of
softener components**

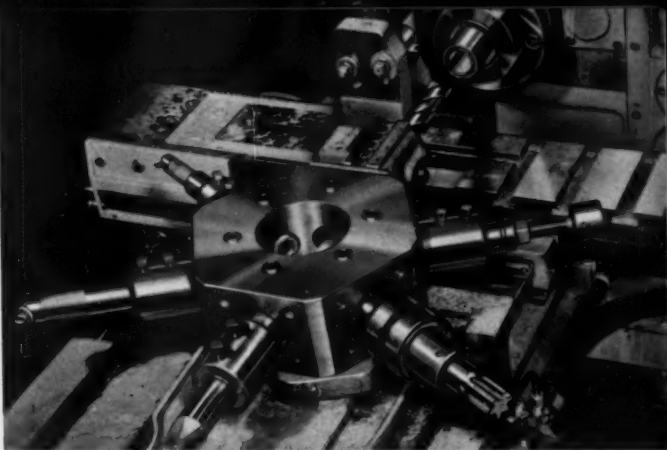
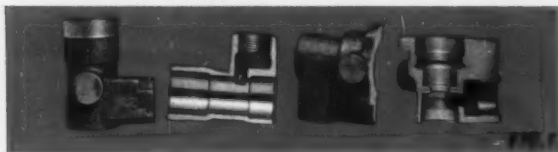


An automatic turret lathe, capable of handling both bar and chucking work, that changes over in an hour or less, may be what you need to cut costs in your shop. Culligan, Inc., Northbrook, Ill., took advantage of these features as soon as the Gisholt MASTERLINE AR (Automatic Ram) Turret Lathe became available. They installed two machines to handle a large variety of small water-conditioning equipment parts, produced in lots of 150 to 3,000 pieces.

One machine has an octagon turret and a 2-jaw automatic indexing chuck. All internal and external machining on four sizes of cast brass valve bodies is completed *automatically*, in one chucking. F.t.f. times range from 1.8 minutes (Fig. 1—left) to 2.2 minutes for complex parts (Fig. 1—right).

The same operator handles the second machine . . . a 5 AR, used for both bar and chucking work. Parts like the bronze flow control body casting (Fig. 2—left) are held in a 3-jaw combination chuck, machined and threaded in only 1.5 minutes f.t.f.

When arranged to produce a 2.411" O.D. plunger ring (Fig. 2—right) from bronze bar stock, the entire cycle is automatic through cut-off and cycle repeat.

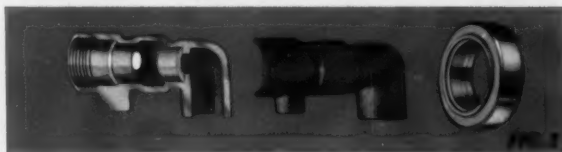


Plunger rings are machined from bronze bar stock with this setup. Automatic cycle includes collet open, feed stock to length, collet close, machine and thread I.D. from hex turret, face, form O.D. and cut-off from front of cross slide, and cycle repeat.

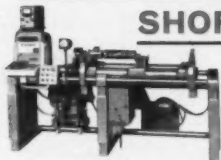
After the first two years of operating 16 hours a day, 5 days a week, Culligan, Inc. has obtained an average saving of 60% on all parts handled. Because the AR is simply an automatic ram type turret lathe, standard and special tooling that was a part of previous methods could be used on the new AR Turret Lathes. Other benefits included reduced handling, improved accuracy, quality and tool life, more consistent production rates and more efficient utilization of manpower.

AR Turret Lathe combines turret lathe versatility with automatic cycle . . . saves 60% on variety of standard and complex parts. One hour changeover for bar and chucking work offers cost advantages for large and small manufacturers.

For more information on AR's, circle No. 765.



LINCOLN ELECTRIC SIMPLIFIES SHORT-RUN BALANCING



**Adjustable cradle handles
over 83 different parts**

The Lincoln Electric Co., Cleveland, Ohio, is a leading manufacturer of arc welding machines, electrodes and supplies, special electrical machinery and ac motors. At present, they offer five types of dc motor-generator welders requiring over 83 different armature and rotor assemblies. Lots range from 5 to 100, weights from 58 to 451 lbs. Their problem . . . how to accurately balance and correct these parts in two planes, at low cost . . . with minimum investment in new equipment.

The answer . . . a Gisholt MASTERLINE 3S Balancer with an extended bed. The 3S permitted balancing at operating speeds and offered capacity, quick setup and ease of calibration to show unbalance in terms of the correction method actually used. This last item was especially important to them because parts are corrected by soldering, welding, or addition of washers . . . or combinations of any two methods. Extra handling was eliminated too, because work is corrected and inspected before it leaves the machine.

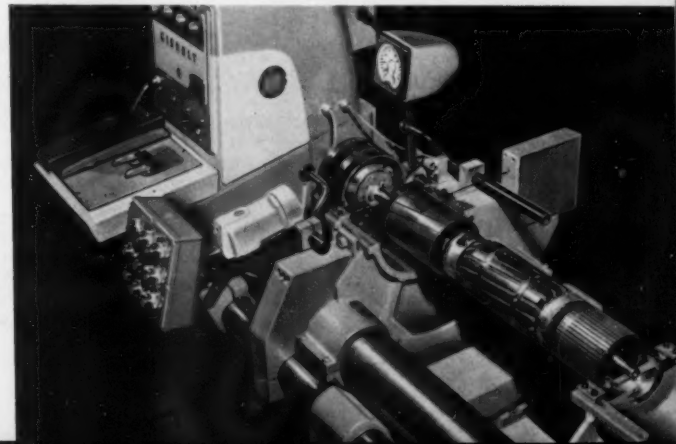
Motor generators are belt-driven over angularly graduated pulley at left using keyed sleeve bushing to connect. Here, half bearings are used. Parts with anti-friction bearings can also be supported in the fixture.

Idle time is at a minimum. A cradle fixture quickly adjusts for various lengths. A belt-driven, angularly graduated pulley connects to the work with keyed bushings for each size. Work can be rotated at any speed from 900 to 3600 rpm. Four main speed adjustment settings are pre-set and obtained through a selector switch.

Time to locate and measure unbalance in both planes ranges from 1 minute to 1.50 minutes. Correction time varies depending on the part and method used.

Versatile setup cuts time to minimum . . . assures complete accuracy . . . eliminates guesswork. One operator locates, measures, corrects and inspects for balance in both planes on one machine. Capacity and flexibility of 3S Balancer make it ideal for short- or long-run operations.

For information on Balancers, circle No. 766.





SUPERFINISH INCREASES SLITTING SAW LIFE FOR BROWN & SHARPE

Gisholt "Productivity Team"
approach pays off . . .
produces a "Sawperior" product

Mr. Colin Sharp, Director, Research & Development Lab., Cutting Tool Division, Brown & Sharpe Mfg. Co., clearly stated the benefits of full cooperation between customer and supplier in a current metalworking publication.

He said, "About two years ago, we were exploring the possibilities of new, high-speed steels and heat treatment for saws, when a Sales Engineer from the Gisholt Machine Company called on us to discuss its Superfinishing process. This was a timely visit, and his claims for smooth, hard surfaces, free from grinding marks and softness sounded promising. It wasn't long after this that we had samples of Superfinished saws for testing and later purchased a machine for production."

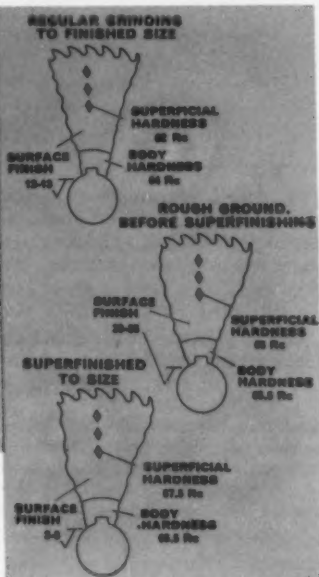
The machine, a MASTERLINE Model 81 Vertical Superfinisher is used on 18 sizes of slitting saws from 2½" to 6" diameter. Formerly Brown & Sharpe ground to a 12-13 micro-inch surface. Now, they grind to 30-35 micro-inches, leaving .001" to .0015" stock per side. Superfinish then removes the outer "skin" that has been softened by grinding



Saws are held in a special fixture on a magnetic chuck to minimize distortion. Dial indicators are used to speed setups because the Superfinish quill supporting head and special swivel wheel holder must adjust to match the concavity of the saw. Superfinishing wheel and work spindle rotate in opposite directions to provide surface speed needed for best results.



Hardness of Superfinished surface is proven by this photograph from Brown & Sharpe, which shows slitting saws being struck against one another with no resultant damage.



heat and exposes the true base metal so that hardness is uniform, across the entire saw face. A 2-3 micro-inch rms surface is produced in 30 to 45 seconds f.t.f. depending on part size.

Superfinish plus new saw geometry provides these advantages . . . and again, we quote Brown & Sharpe: (1) "Superfinished sides permit less concavity or side clearance providing a stronger saw section and a stiffer, more accurate saw; (2) . . . without noticeable scratches on the sides there is less tendency for cracks to develop; (3) . . . smooth finish resists scratching, resists corrosive action of coolants and rust . . . even though left for a considerable time in a humid atmosphere; (4) . . . new saw geometry and Superfinished sides give up to four times as much slitting production between sharpenings and smoother finishes . . . prevents chips from seizing and galling, requires less power and allows heavier cuts without strain or chatter."

Acquaint your Gisholt Representative with your new projects. He will turn them over to the Gisholt "Productivity Team" . . . experts in the fields of machining, threading, Superfinishing and balancing. You can be sure that our combined efforts will help you "do it for less".

For information on Superfinish, circle No. 767.

GISHOLT

MACHINE COMPANY
Dept. 805, Madison 10, Wis.

The Gisholt Round Table represents the collective experience of specialists in the machining, surface-finishing and balancing of round and partly round parts. Your problems are welcomed here.

Turner Lathes • Automatic Lathes • Balancers • Superfinishers

Threading Lathes • Packaging Machines • Masterglas Molded Plastic Products



No. 9-1061
805

Printed in U.S.A.

FOURTH DAY DOWN... Until Cimplus took over!

Here's an actual case history of another plant that has discovered the remarkable qualities of rust-controlling CIMPLUS, transparent grinding fluid of the famous CIMCOOL family. (Company name on request.)



FIELD SERVICE REPORT

The job was grinding cast iron machine tool parts on three rotary surface grinders with an 1800 gallon central cutting fluid system.

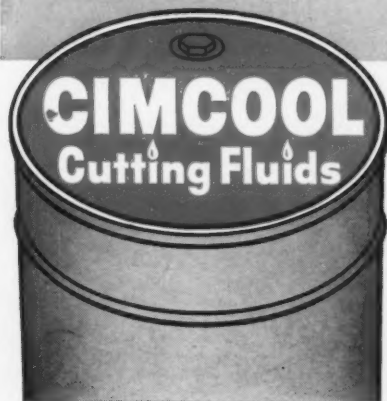
The coolant they had been using had let the sludge cake up and clog up the lines and they had been shut down for four days. Then we installed Cimplus at 100 to 1 dilution and the problem was solved.

Since Cimplus took over, they've had no sludge trouble at all.
The swarf and grit settles nicely for them, but it doesn't cake. They're also real pleased with the rust prevention on the cast iron parts that Cimplus gives them.

Kent Reece

N. Y. Office

Page 2



FOR 100% OF ALL METAL CUTTING JOBS
Production-proved products of The Cincinnati Milling Machine Co.

CIMCOOL S2 Concentrate — The pink fluid which covers 85% of all metal cutting jobs.
CIMPERIAL® — Newest in the famous, industry-proven line of CIMCOOL® Cutting Fluids.
CIMPLUS — The transparent grinding fluid which provides exceptional rust control.
CIMCUT Concentrates (AA, NC, SS) — For every job requiring an oil-base cutting fluid.
ALSO — CIMCOOL Tapping Compound — CIMCOOL Bactericide — CIMCOOL Machine Cleaner.

For full information on the complete family of CIMCOOL Cutting Fluids, call your CIMCOOL Distributor. Or contact Cincinnati Milling Products Division, Cincinnati 9, Ohio.

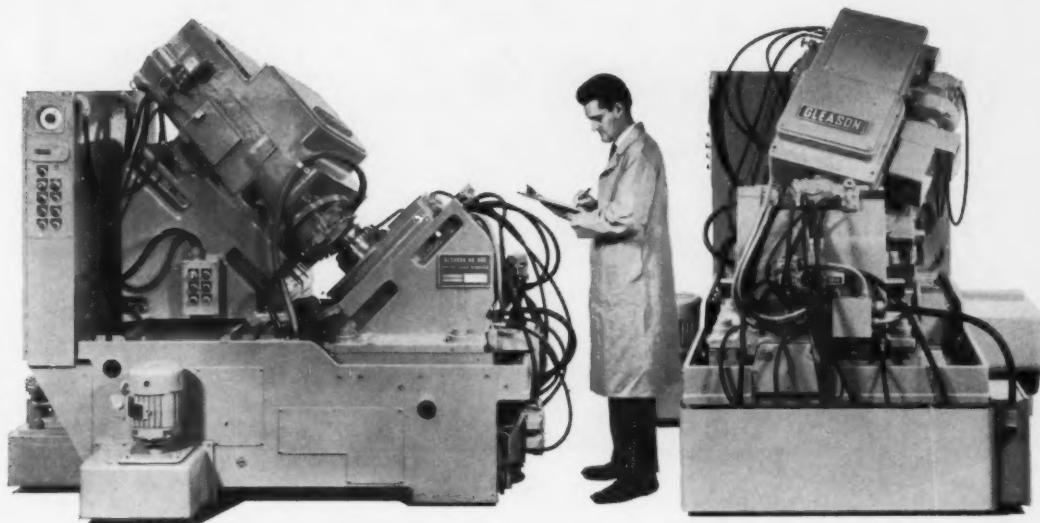
*Trade Marks Reg. U. S. Pat. Off.



... PRODUCES QUIET, ACCURATE GEARS, UP TO 50% FASTER... AND SAVES FLOOR SPACE. These new Gleason "inclined-spindle" Hypoid Gear Cutting machines are primarily designed for faster, more accurate roughing and finishing of automotive main drive gears up to 10½" O.D. ■ Unique "inclined-spindle" design provides greater rigidity for precision cutting. ■ New type cutters, faster index and work clamp arrangements combine with automatic loaders to increase production up to 50%. ■ Yet, these new machines occupy 35% less floor space than pre-

vious machines. ■ Set-up and operation are simplified... only four summary settings with simple gage bars to relate work and cutter. Any number of machines can be set-up with the same gage bars to produce identical gears... no expensive set-up fixtures needed. ■ New magnetic chip removal and coolant systems assure constant forced flow of clean oil over the work... help prolong cutter life, eliminate periodic cleaning, and minimize coolant loss. ■ For information on these all-new machines write Gleason Works, 1000 University Avenue, Rochester 3, New York.

A BRAND NEW ANGLE IN GEAR CUTTING . . .



NEW GLEASON No. 606 Hypoid Gear Rougher

NEW GLEASON No. 607 Hypoid
Helixform Gear Finisher

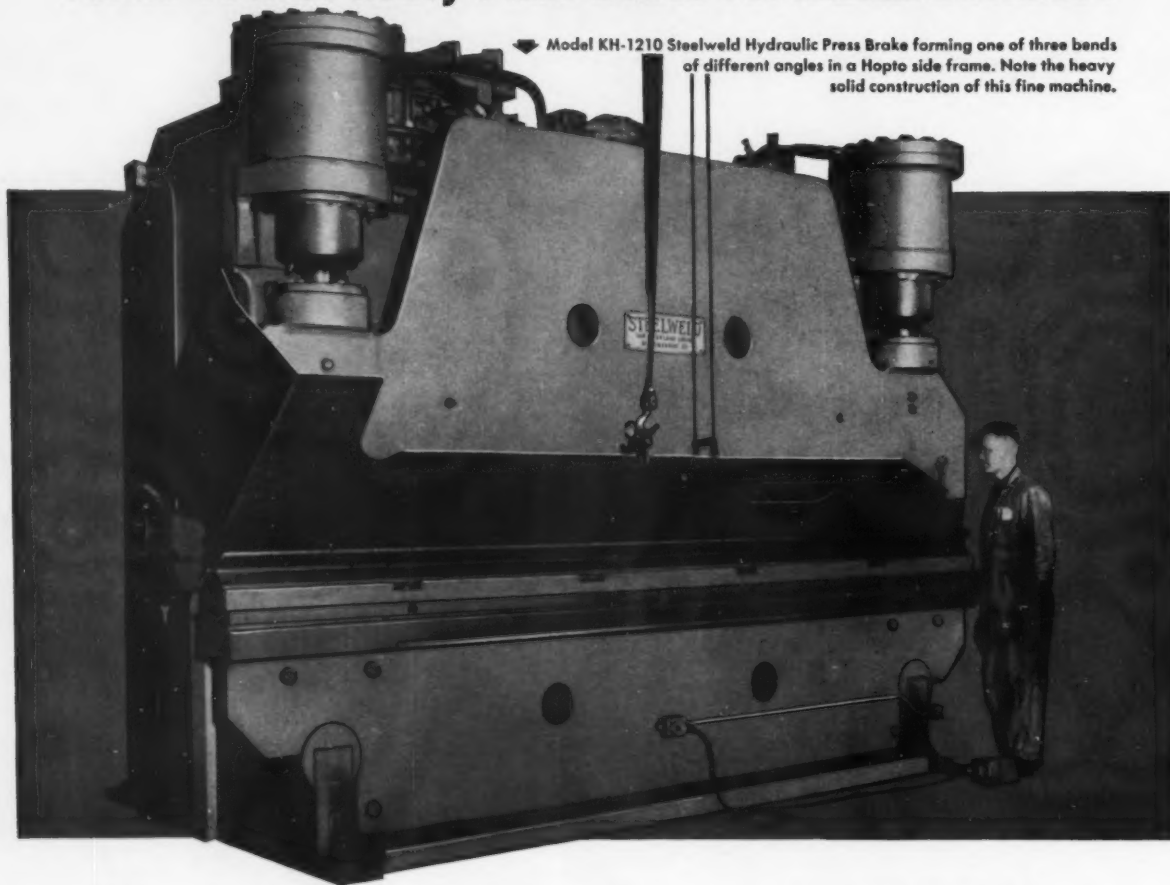


Practically all bends in the steel in these booms for Model 500 Hoptos were produced on the press brake below.



Model 500 Hopto of $\frac{3}{4}$ yard capacity. Like the Steelweld Press Brake on which so much of the steel for this machine is formed, Hopto is completely hydraulic in operation. This eliminates many wearing parts and provides long trouble-free life.

STEELWELD HYDRAULIC PRESS BRAKE Forms 90% Of Heavy Plate Bends For **Hopto** Backhoes



Model KH-1210 Steelweld Hydraulic Press Brake forming one of three bends of different angles in a Hopto side frame. Note the heavy solid construction of this fine machine.

A 400 ton Steelweld Hydraulic Press Brake is a key machine in the production of Hopto Backhoes at The Warner & Swasey Company, Badger Division, Winona, Minnesota. 90% of the many bends on various thickness plates required in the Hopto construction are made on the Steelweld machine.

The press brake has speeded production enormously because bends of different degrees can be made quickly and repeatedly on a simple set of four-way dies by presetting a ram adjustment. This determines the length of ram travel and makes possible changing the setting from one angle to another

in about the time required to snap one's fingers.

The machine delivers accurate bends to close tolerances. It is easy and safe to operate. Although it is practically always in use, no time is lost for servicing. It has proven to be a big help in lowering production costs.

Write for free booklet No. 2024

STEELWELD
MECHANICAL and HYDRAULIC
PRESS BRAKES



Steelweld Machinery includes: Mechanical & Hydraulic Shears and Press Brakes, One-, Two- and Four-Point Straight-Side Presses, Speed-Draw Presses.

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Namco DBS Vers-O-Tool gives... 50 times more pieces per grind

...for Stevens Manufacturing Company *



When Stevens Manufacturing Company, Lexington, Ohio equipped a Brown & Sharpe No. 2 automatic with a NAMCO $\frac{3}{8}$ " DBS Vers-O-Tool, the increased threading efficiency was astonishing. On the part shown, pieces-per-grind soared from an average of 1000 to 50,000; scrappage dropped 90%; production increased by $2\frac{1}{2}$ times; tolerance trouble became a thing of the past. Stevens finds such performance typical for the DBS. A non-revolving threading tool, it's designed specifically for B & S automatics; has an exclusive automatic opening and closing mechanism for unmatched precision in cutting close-to-shoulder threads. Available capacities are shown below. Thousands of manufacturers use NAMCO threading tools to slash threading costs and improve thread quality. Our 44 page bulletin DT-60 will give you all the details. Get in touch. We'll be happy to send you a copy.

Size Die Head Inches	Brown & Sharpe Machine Size†	Straight Threads		Adjustment for Diameter		Capacity Pipe Threads Inches	Coarsest Standard Pitch
		Min. In.	Max. In.	Minus	Plus		
DBS $\frac{1}{4}$	No. 00-O-00G-06	.056	$\frac{1}{4}$	.031	.004	$\frac{1}{4}$	18
*DBS $\frac{1}{2}$	No. 0-O-0G-2	$\frac{3}{4}$	$\frac{3}{4}$	.071	.012	$\frac{1}{2}$	16
†DBS $\frac{3}{4}$	No. 2	$\frac{3}{4}$	$\frac{3}{4}$	.068	.020	$\frac{3}{4}$	11

*Chasers and blocks interchangeable with $\frac{1}{4}$ " DR and $\frac{1}{4}$ " DS die.

†Chasers and blocks interchangeable with $\frac{1}{4}$ " DR and $\frac{1}{4}$ " DS die.

‡And corresponding BSA sizes. Larger capacity Vers-O-Tools for B & S and BSA machines can be furnished on application.

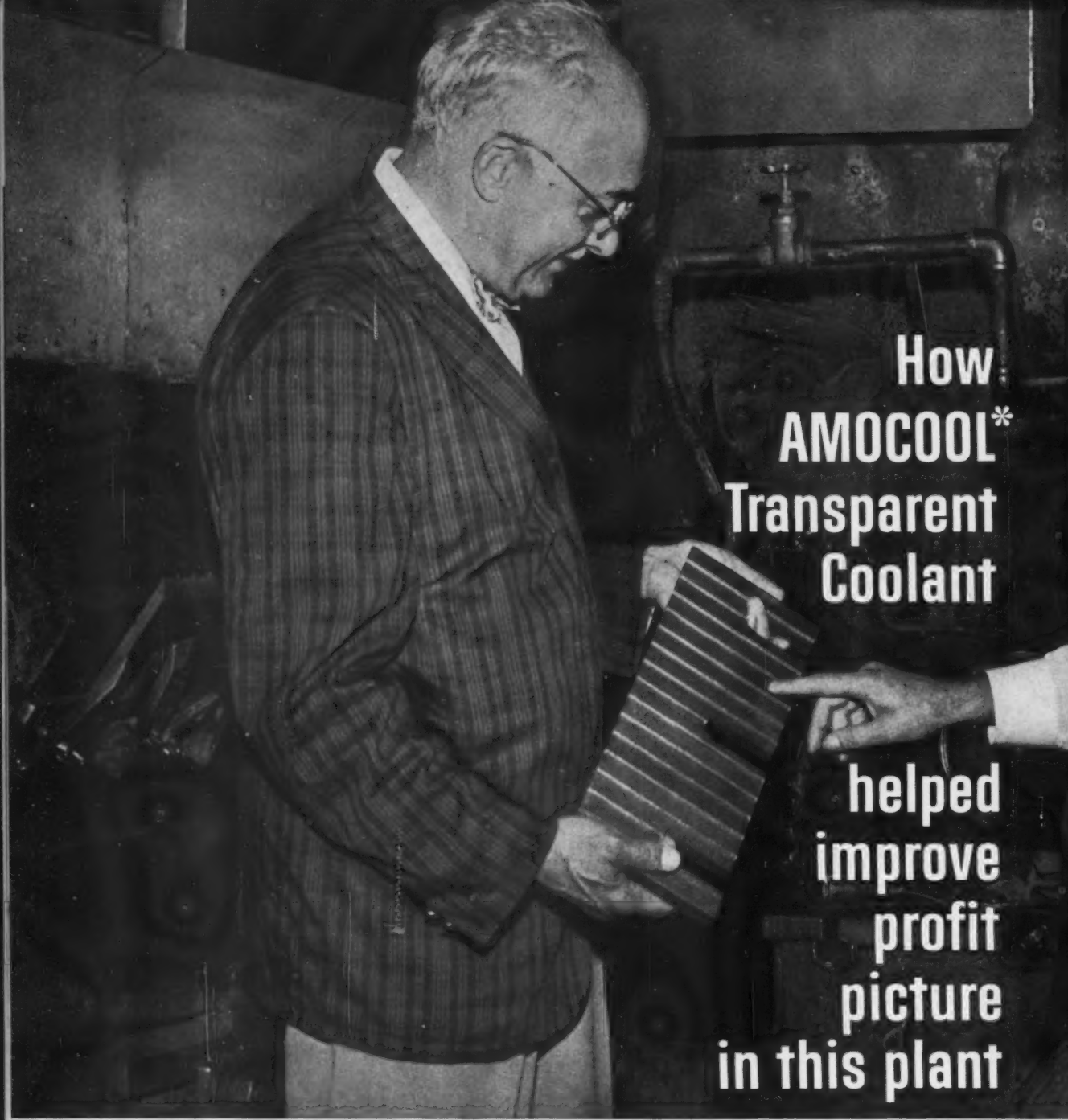


* Aluminum expansion tube for Stevens Type H adjustable thermostat. Thread specifications: class—2; pitch—56, diameter— $\frac{1}{4}$ ", length— $\frac{1}{2}$ ", tolerance $\pm .010$ (actual size)

National Acme

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How **AMOCOOL*** Transparent Coolant

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improve
profit
picture
in this plant

*Trademark



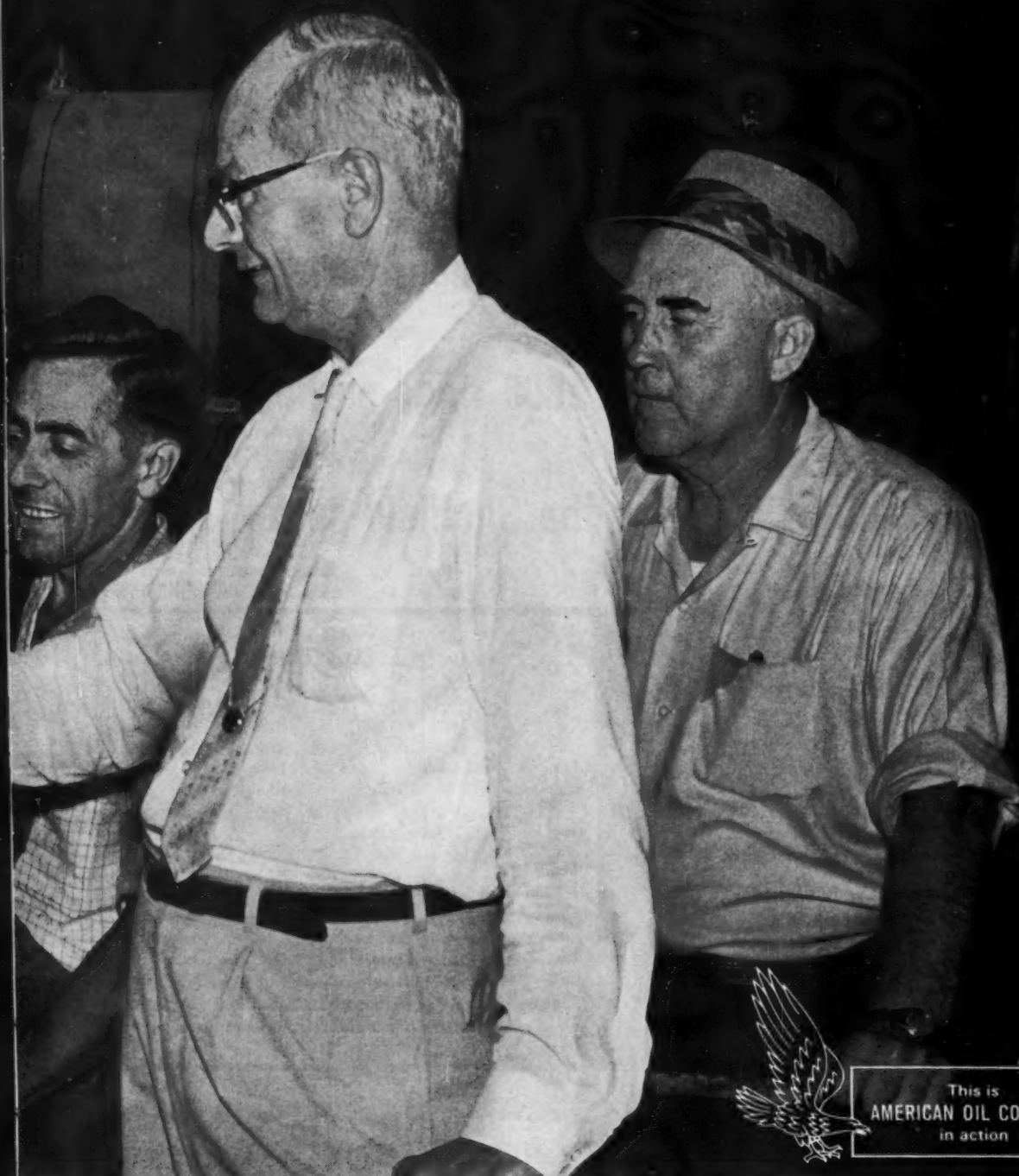
BY PAUL E. "PAPPY" STRATTON

About the Author. "Pappy" Stratton has been providing technical help on lubrication and metalworking problems to customers in the Detroit area for nearly all of the twenty-five years he has been working for the company. In addition to having this store of practical experience to help him, Pappy has completed the Company's Sales Engineering School.

* * *

By using a soap-base grinding compound, Detroit Edge Tool Company was getting excessive corrosion and rust on work and grinding machines. Oil vapor was collecting on machines and on the ceiling, causing dirty working conditions. Most important, high wheel loading was causing frequent down-time for wheel dressings.

We worked out a test program on AMOCOOL Transparent Coolant with the management. On our first test on one surface grinder, feed pressure was cut substantially while at the same time metal removal was increased.



This is
AMERICAN OIL COMPANY
in action

Eliminate reworking because of rust, reduce wheel loading and extend intervals between wheel dressings; do these and you increase profit per unit, explains Detroit Edge Tool president, Dan Ebbing, to P. E. "Pappy" Stratton of American Oil. Plant manager, John Yonker (right) and Sam Vineh, operator, look on.

The cost of reworking parts to remove rust was eliminated. Time required to clean machines to get rid of the odor was cut in half. Less wheel loading and fewer wheel dressings have upped production and reduced costs. Our test program paid out in an improved profit picture. All grinding and drilling equipment has been converted to AMOCOOL Transparent Coolant.

Would you like this kind of technical help to assist you in improving profits? Get it by calling the American Oil Company office nearest you.

**Quick facts about
AMOCOOL
Transparent Coolant**

- Clear, transparent fluid
- Controls corrosion on work and machines
- All chemical. Does not support bacteria growth
- Unaffected by humidity
- Fire resistant.
- Odorless



**AMERICAN OIL
COMPANY**

910 South Michigan Avenue
Chicago 80, Illinois

A Sheffield sorter* sorts 2000 rings an hour

2000 rings an hour

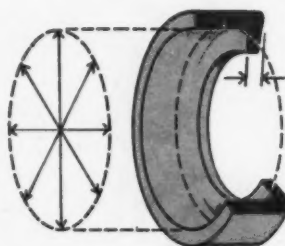


a Sheffield sorter* sorts.

If a Sheffield sorter* sorts 2000 rings an hour



Where are the 2000 rings the Sheffield sorter* sorts?



*This Sheffield automatic gaging, classifying and segregating machine inspects up to 2,000 rings an hour for the Western Electric Company. It simultaneously measures inside diameter and flange thickness, classifies rings into 15 sizes plus out of tolerance, and rejects each size in its chute. Its speed and accuracy have resulted in appreciable manufacturing savings.

One of them is in your telephone.



Pick it up and call SHEFFIELD
for further information on
automatic gaging and assembly
machines. CL 4-5377, Ext. 211, 212, 213.

The
SHEFFIELD
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Dayton 1, Ohio

A subsidiary of the Bendix Corporation

Gages, Measuring Instruments, Automatic Gaging & Assembly Systems • Machine Tools • Contract Mfg.

Combat Rising Costs?

LUCAS

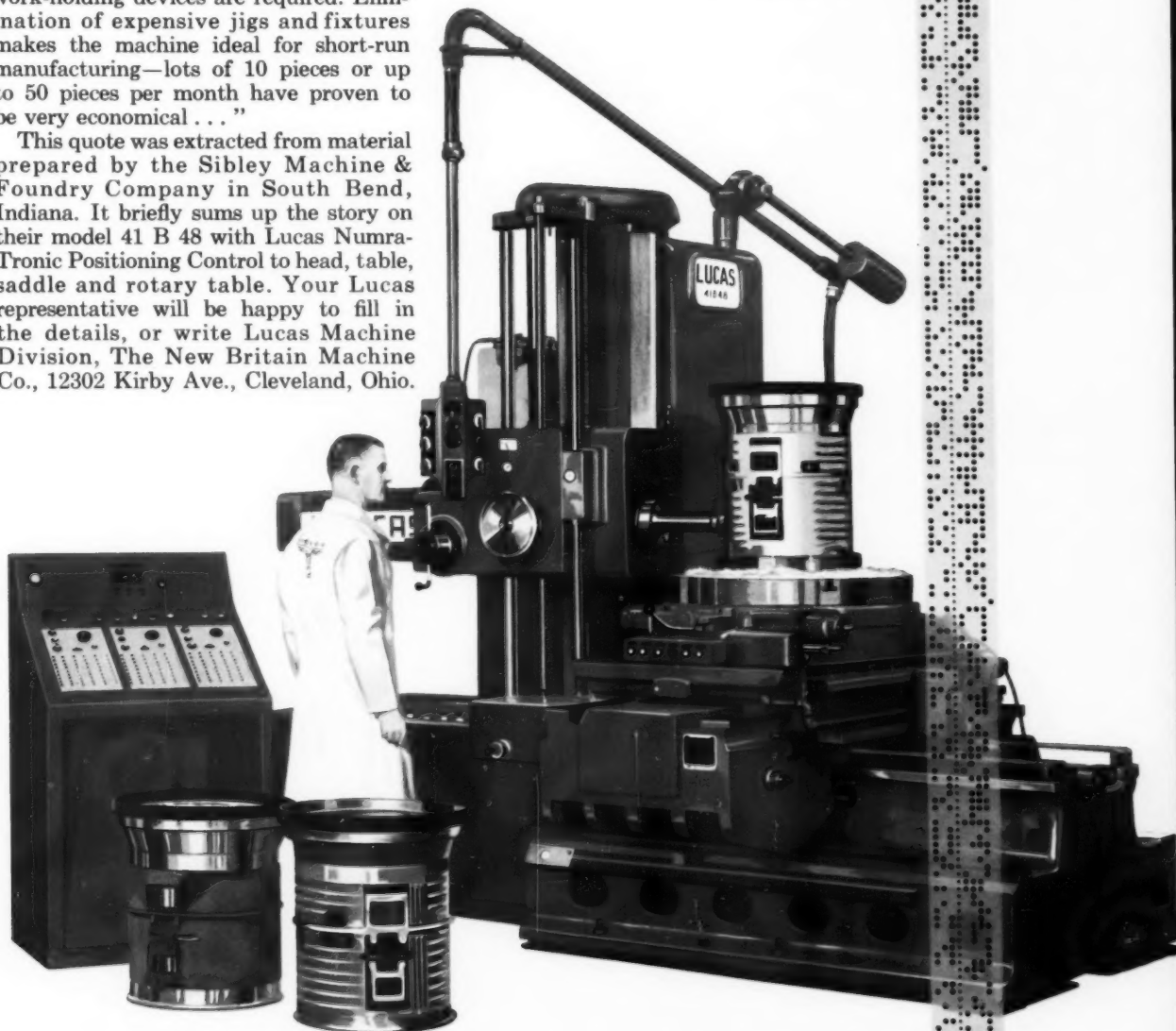
"The advantages of numerical control, combined with the precision quality of the Lucas boring machine are currently reducing manufacturing costs at Sibley on . . .

- Complicated missile hardware for a major prime contractor.
- Short-run lots of gray iron castings for equipment builders.
- Major components of the Sibley HT-40 tape controlled drilling machine.

With this boring machine, only simple work-holding devices are required. Elimination of expensive jigs and fixtures makes the machine ideal for short-run manufacturing—lots of 10 pieces or up to 50 pieces per month have proven to be very economical . . . "

This quote was extracted from material prepared by the Sibley Machine & Foundry Company in South Bend, Indiana. It briefly sums up the story on their model 41 B 48 with Lucas Numra-Tronic Positioning Control to head, table, saddle and rotary table. Your Lucas representative will be happy to fill in the details, or write Lucas Machine Division, The New Britain Machine Co., 12302 Kirby Ave., Cleveland, Ohio.

LUCAS
PRECISION



Choice of Controls?

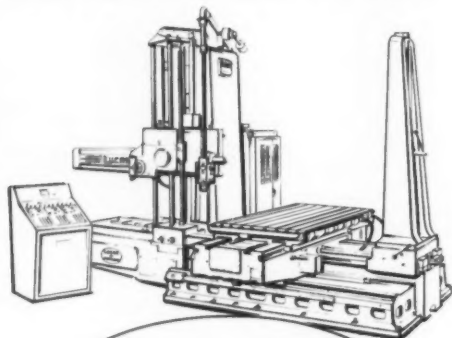
LUCAS

Lucas offers a complete selection of controls for every machine motion. You can select combinations of pendant and lever control, full pendant control and partial or full numerical control.

The Multiple Control Pendant selects speeds, feeds, unit travels, rapid traverse of head, table, saddle and spindle, plus spindle rotation forward and reverse, jog and stop. Preselection of speeds and feeds may be accomplished while the machine is in operation.

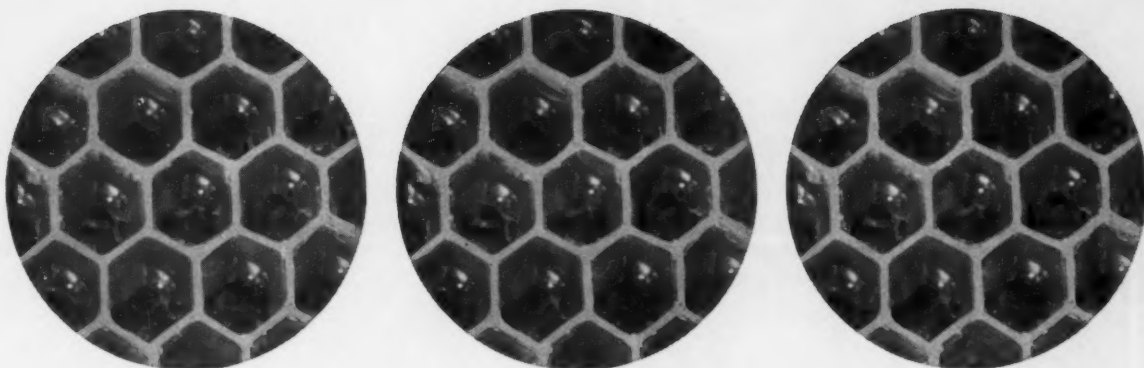
Numerical control can select travel of head, spindle, table and/or saddle, unclamp units when in motion and clamp when directed. Other functions—tapping cycle, changing of feeds and speeds, spindle power tool lock clamps or ejects tools, spindle dwell, coolant "on" or "off", orientation of spindle stop at a desired point of rotation when using tool magazine, simultaneous motion of unit travels, dual storage of information.

One piece or production runs... 2¼", 3", 4", 5", 6" or 7" spindle-diameter models, simple jobs or complex jobs, Lucas has the right horizontal and vertical boring, drilling and milling machines with the controls you need. See your Lucas representative or write Lucas Machine Division, The New Britain Machine Company, 12302 Kirby Ave., Cleveland, Ohio.



LUCAS
PRECISION





POSITIVE DUPLICATION—EVERY TIME!



One of nature's enduring, dependable marvels is the structure of honeycombs—formed exactly the same way time after time after time. This is Positive Duplication—yours also with these CINCINNATI CENTER-TYPE GRINDING WHEELS, and with *all* CINCINNATI **PD**° WHEELS.

HOW "PD" IS ACHIEVED

To produce grinding wheels of unsurpassed uniformity, Cincinnati developed its unique **PD**° manufacturing process, involving 36 quality controls. These rigid controls govern every step of wheel production. They achieve, for example, tolerance for wheel inside diameters which are the "tightest" in the industry. So your CINCINNATI WHEELS have better balance, require less dressing and last longer.

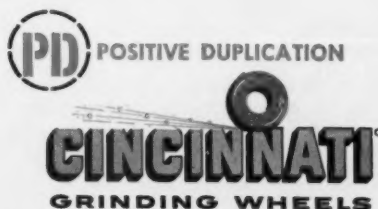
HOW "PD" PAYS OFF FOR YOU

The uniformity and longer wheel life you get permits you to plan production schedules with the assurance

that each reorder wheel will act and grind exactly like the original. This is the promise—and *performance*—of Positive Duplication.

CUT COSTS . . . CALL CINCINNATI NOW

You can solve your grinding problems with the help of specialists trained by the Cincinnati Milling Machine Co. Their wide experience in job set-ups and grinding operations is at your service. Just call your CINCINNATI GRINDING WHEELS Distributor or contact Cincinnati Milling Products Division, Cincinnati 9, Ohio.

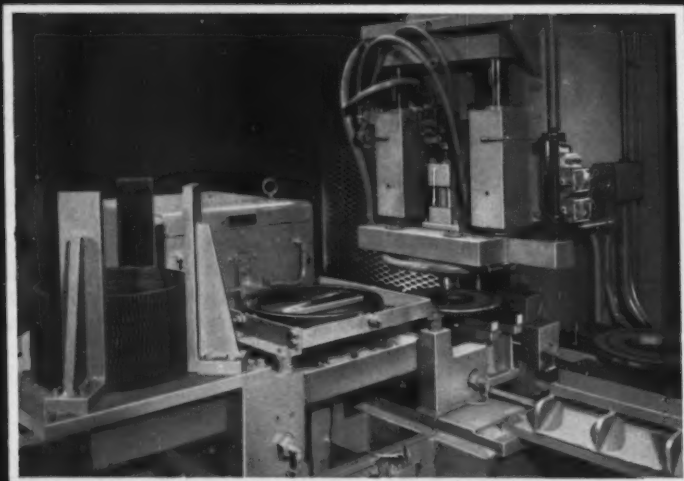


A PRODUCTION-PROVED PRODUCT OF THE CINCINNATI MILLING MACHINE CO.

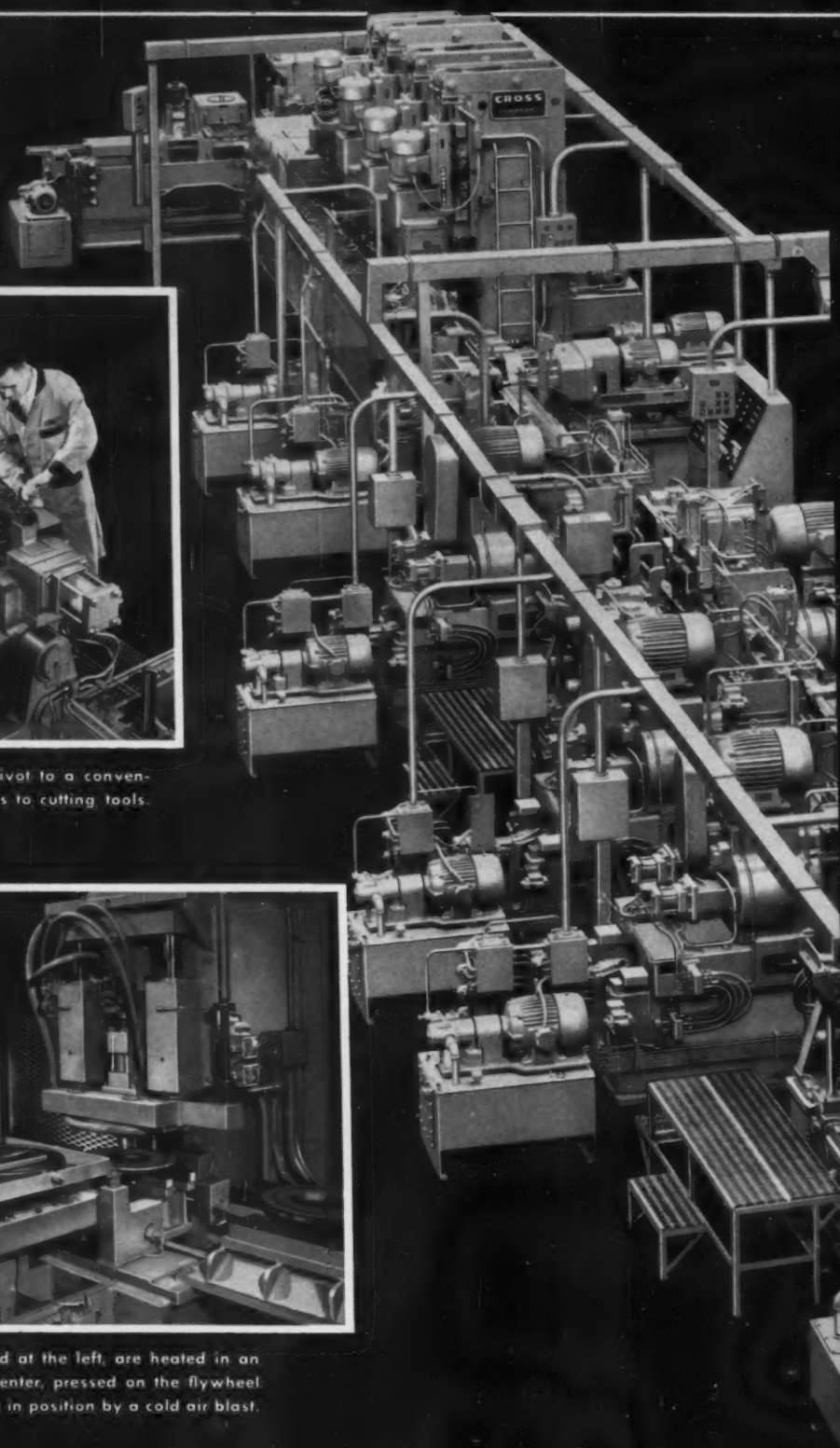
°Trade Mark Reg. U.S. Pat. Off.



In Section I, tool slide units pivot to a convenient position for ready access to cutting tools.



The ring gears, stacked at the left, are heated in an induction coil in the center, pressed on the flywheel at the right and shrunk in position by a cold air blast.



Another Automation First by Cross

Transfer-matic Completely Processes Flywheels and Assembles Ring Gears

*Machining Operations Include Facing, Turning,
Boring, Chamfering, Drilling and Tapping*

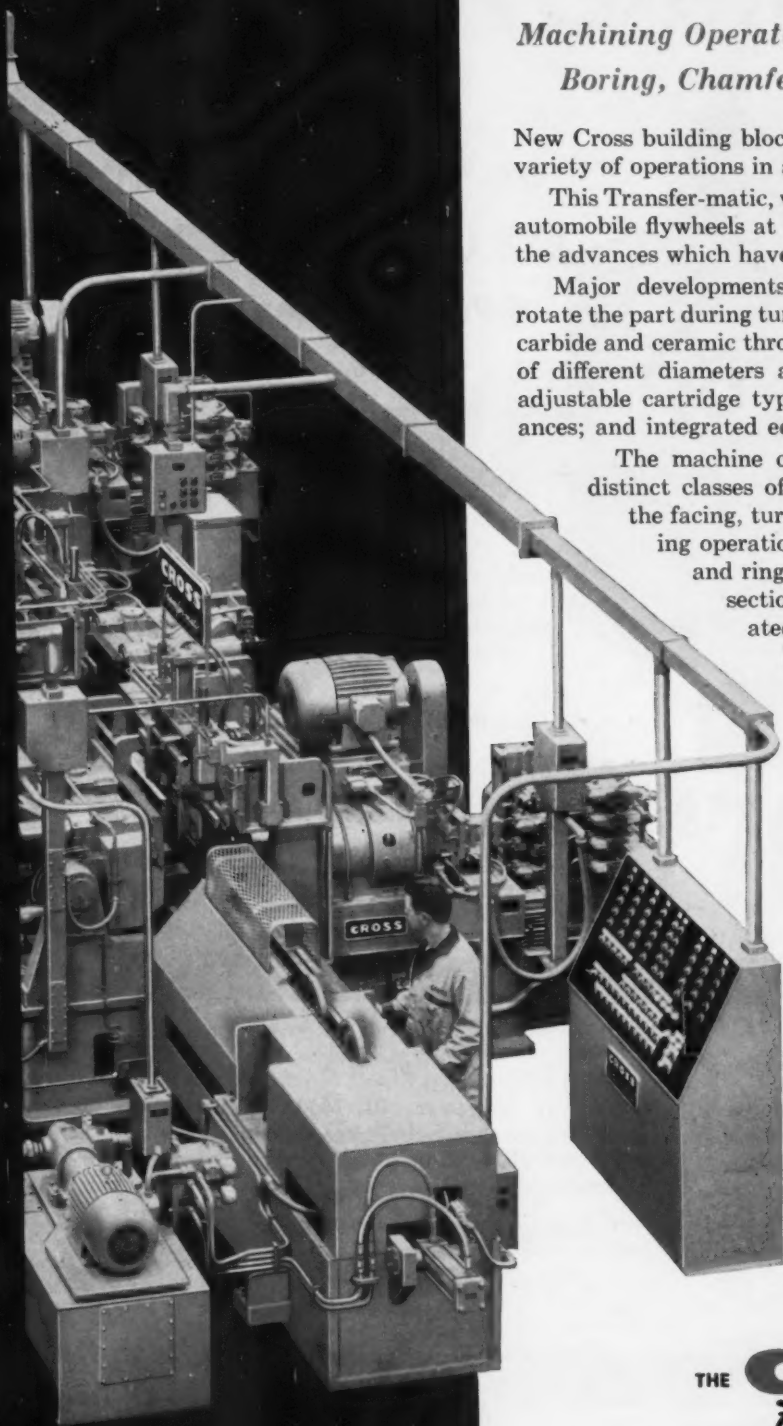
New Cross building blocks make it possible to complete a wide variety of operations in addition to drilling and boring.

This Transfer-matic, which completely processes two different automobile flywheels at the rate of 132 per hour, is evidence of the advances which have been made.

Major developments include standard chucking units to rotate the part during turning, facing, and boring; the use of both carbide and ceramic throw-away inserts to assure proper cutting of different diameters at a single spindle speed; individually adjustable cartridge type tool holders to maintain close tolerances; and integrated equipment to assemble the ring gear.

The machine consists of two sections to handle two distinct classes of operations. The first section performs the facing, turning, boring, undercutting and chamfering operations. Drilling, reaming, tapping, cleaning and ring gear assembly take place in the second section. The two sections are normally operated as one machine. A banking station between sections permits either to continue when the other is stopped for tool changes.

Quick changeover for the two flywheel designs is achieved by such features as the use of eccentric spindles to machine different hole patterns.



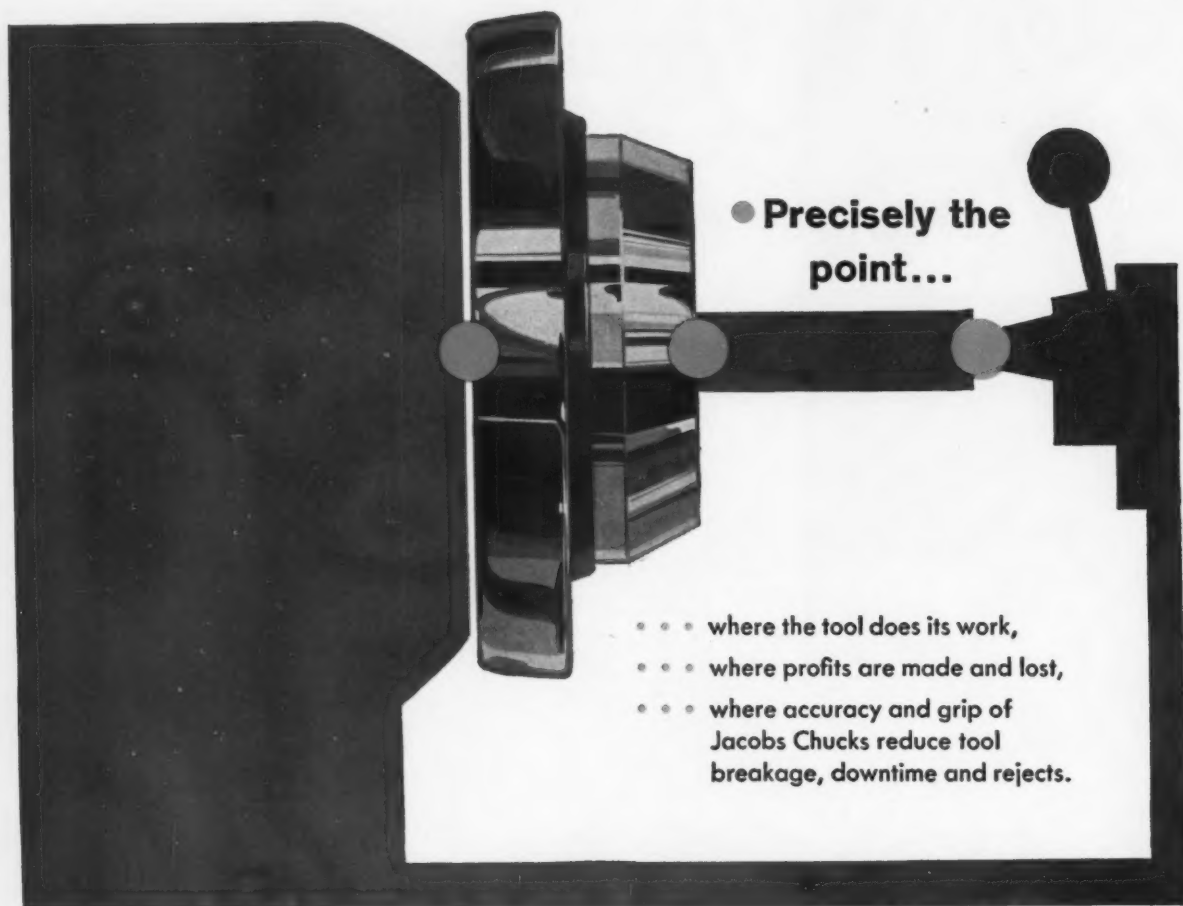
Established 1898

THE **CROSS** CO.
First in Automation

PARK GROVE STATION • DETROIT 5, MICHIGAN

**When you buy new tools or
four factors come first**

ACCURACY GRIP



The Jacobs Model 50 is the world's most modern collet chuck. Model 50 and its entirely new series of Jacobs Rubber-Flex collets have been developed especially for Atlas, Clausing, Delta, Logan, Sheldon, South Bend and similar lathes. With Model 50 on your lathe you get a lot more for less.

ACCURACY is greater with Model 50 because collet jaws are always parallel and maximum run-out is .001" T. I. R. at the nose, when properly mounted.

GRIP is greater because the extra long collet jaws have tremendous torque capacity.

modernize your old ones at the chucking end

RANGE PRICE

COMPLETE SET OF 10
RUBBER-FLEX® COLLETS
CHUCK ANY BAR
BETWEEN
 $\frac{3}{32}$ " and $1\frac{1}{16}$ "



RANGE is greater because the 10 Rubber-Flex collets in this new series cover a greater bar stock range than 63 old-fashioned split steel collets100" range per collet.



PRICE is revolutionary!

\$70⁰⁰

Model 50
Collet Chuck

\$65⁰⁰

Complete set of 10
Rubber-Flex Collets

This performance at these prices proves the point. You can't afford not to modernize your lathes with Jacobs Model 50 and Rubber-Flex collets.

See your Jacobs industrial supply distributor. Give him the opportunity to prove the facts with a demonstration at your desk! Call him today. If you'd like further details before you call, write Jacobs, Department 196 at the address below.

Jacobs

CHUCKS



THE JACOBS MANUFACTURING COMPANY,
WEST HARTFORD, CONNECTICUT

Sweet Music for Tomorrow



Just as manufacturers the world over choose famous V-M Record Changers for their dependability and full fidelity of performance, V-M chooses South Bend 13" Toolroom Lathes.

They demand exacting model work and they get it on these precision lathes—every time. If your experimental or production work require exceptional tolerances and fine finishes, you'll be

interested in what you can accomplish on South Bends. Write now for complete information.

Prices of 13" Toolroom Lathes start at \$2358, a time payment plan is available.



Machining a turntable in the Model Shop of V-M Corporation, Benton Harbor, Michigan.



SOUTH BEND LATHE

SOUTH BEND LATHE, Inc.
South Bend 22, Indiana

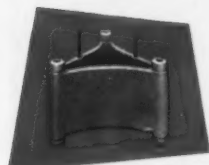


Builders of Lathes • Milling Machines • Shapers • Drill Presses • Pedestal Grinders



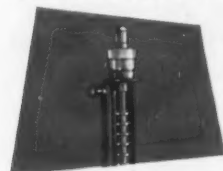
7 PLA-CHEK GAGES stand guard over Ford precision and accuracy in this Layout and Inspection room at Ford Motor Company's Dearborn engine plant in Dearborn, Michigan

7 of 200 Reasons Why Inspections are *Faster at Fords!*



PRECISION RISERS

Built with the same precision as the gages themselves, PLA-CHEK Gage Risers may be used to extend the usefulness of every PLA-CHEK Gage from the smallest to the largest size. Available in 6" height for 6", 12", 18" PLA-CHEKS ... 12" height for 24", 36", 48" models.



MICROMETER THIMBLE

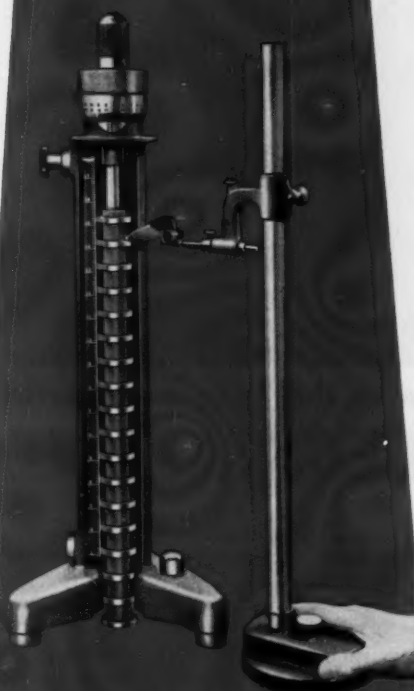
Is graduated to .0001" and provides dimensions between 1" steps on measuring bar. Measuring bar of the 18" model (as illustrated) and larger models, can be adjusted to enable the user to take readings up or down relative to a center line or other reference line on the work.

PLA-CHEK GAGES Guard Ford Precision while Cutting Inspections from Minutes to Seconds

Precision is a law at Ford Motor Company. And speed is essential to the maintaining of high volume production. That's why you'll find more than 200 PLA-CHEK Gages at work in various Ford plants speeding inspections while guarding Ford precision and quality.

PLA-CHEK GAGES, available in a full range of sizes to meet every surface plate inspection and layout requirement, can be set 5 to 20 times faster than other methods of comparable accuracy. They are guaranteed accurate to .00005" throughout the entire range of the 6", 12" and 18" sizes and in the 24", 36" and 48" sizes to .0001" in any 24" length or .0002" over their entire range.

In August, 1946 Ford Motor Company purchased its first PLA-CHEK Gage. Today there are 200 at work in Ford inspection rooms and at Ford machines. Such confidence on the part of Ford Engineers must be deserved. Let us tell you how you, too, can speed inspections, maintain extreme accuracy and save money with PLA-CHEK Gages. Write for complete, detailed literature.



Cadillac

GAGE COMPANY

P.O. BOX 3806 • DETROIT 5, MICHIGAN



with the Texaco "Cleartex Cure" you can
DECREASE REJECTS AS MUCH AS 22%

Diluted cutting oil in automatics can mean a high reject rate. Read why a "Cleartex Cure" ends this dilution problem forever... keeps tool sharp... assures dimensionally accurate work—and reduces rejects as much as 22%.

In spite of precautions, lube oil leaks into the cutting oil sumps of up to 70% of all automatics. Diluted cutting oil not only piles up rejects, but also means shortened tool life, more downtime and substantial discarded cutting oil losses.

How a "Cleartex Cure" works. A "Cleartex Cure" stops this dilution problem. Your reject rate can drop by 22%. Here's why: Cleartex Oil—heart of a "Cleartex Cure"—is used in *both* cutting and lubricating oil sumps. It works as a hydraulic oil, too. Cutting oil strength is always full—regardless of leakage. Because of minimized losses and increased production, you actually slash per-piece production costs as much as 40%.

How to take a "Cleartex Cure." Getting the full benefits of a "Cleartex Cure" is easy. An experienced Texaco engineer will survey your automatic set-up. He'll tell you which machines will benefit from Cleartex. Our illustrated booklet, "Cleartex in Automatic Screw Machines," spells out the benefits of a "Cleartex Cure" in detail.

To get your copy, contact the nearest of more than 2,300 plants distributing Texaco Products, or write:

Texaco Inc., 135 East 42nd Street, New York 17, N. Y.
 Dept. MA-120.

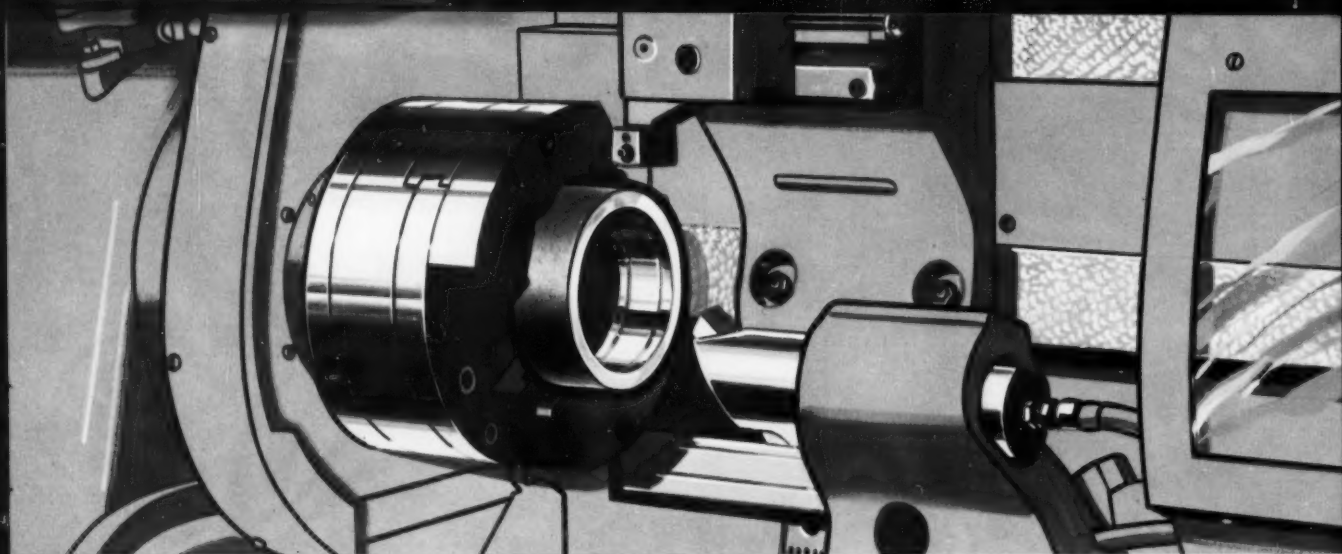
TUNE IN: HUNTLEY-BRINKLEY REPORT,
 MON. THROUGH FRI.-NBC-TV

TEXACO



Throughout the United States

Canada • Latin America • West Africa



Years-ahead flexibility in New Britain's **+GF+** Copying Lathes

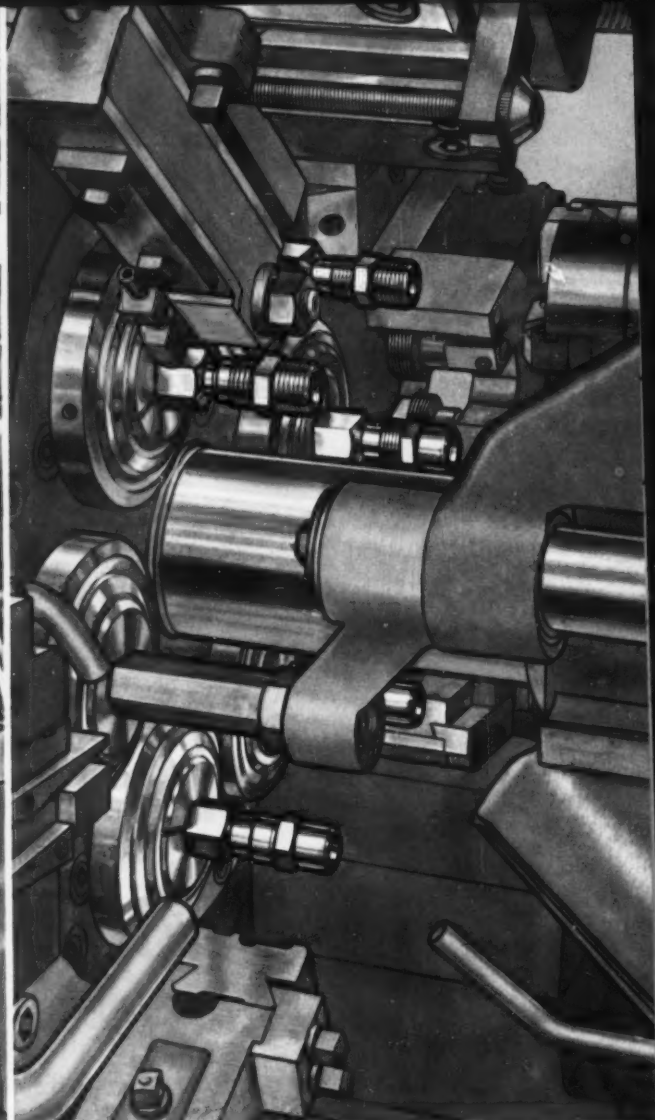
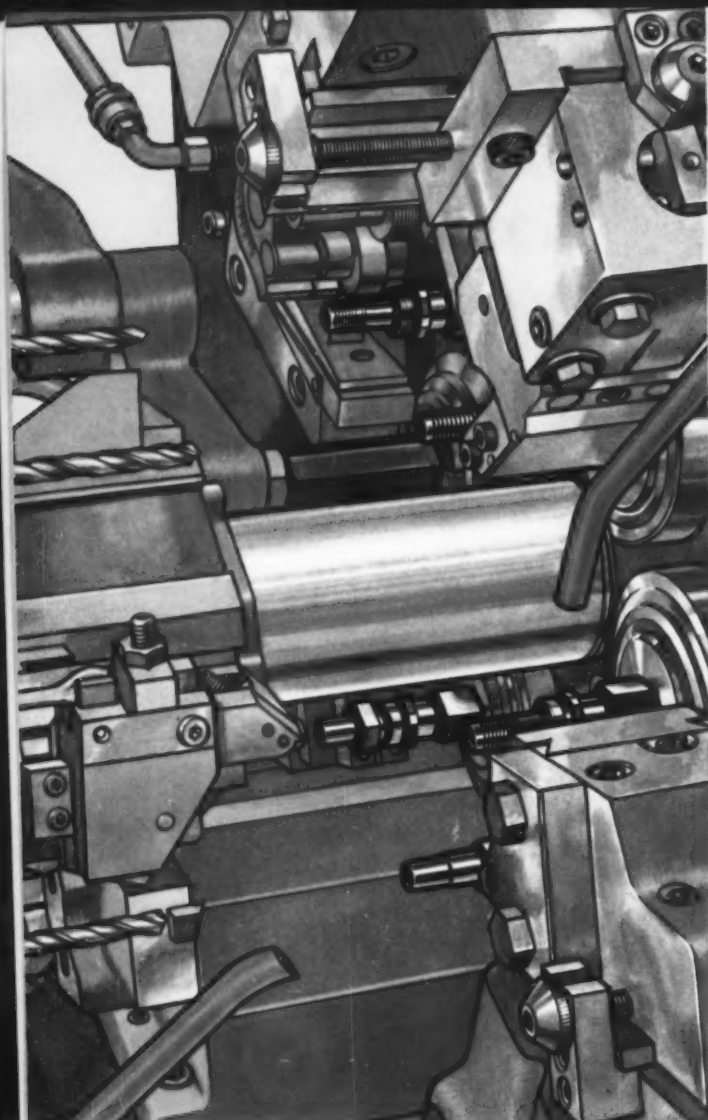


One of the best ways of making sure you're on the right track when you buy a new machine is knowing what you want the equipment to do and then being sure the equipment you buy can do it. This sounds pretty basic, but it's difficult to forecast just what you are going to require of a machine through all the years you will use it. In this department, the New Britain **+GF+** Copying Lathe has a lot of peace-of-mind insurance built right into it. For instance, the basic design of the machine suits it for a wide variety of work. The single-tool copy-turning principle is equally well suited for both chucked and between-centers work on internal and external surfaces.

Because the tool path is controlled by an easy-to-install template (or a prototype) set-up and change-over are accomplished in a few minutes. The cutting tool can be replaced in a matter of seconds. Back facing is accomplished as part of the machining cycle by means of a top-mounted attachment.

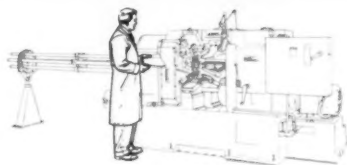
The New Britain **+GF+** is truly a machine that can pull more than its own weight in any metal-working shop. On top of that, it can adapt quickly and easily to the widest possible number of new requirements that may be placed on it in the years to come. A new catalog describes the complete line in detail.

THE NEW BRITAIN MACHINE COMPANY
New Britain-Gridley Machine Division ♦ New Britain, Connecticut



Stainless, 225 per hour — brass, 1500 per hour

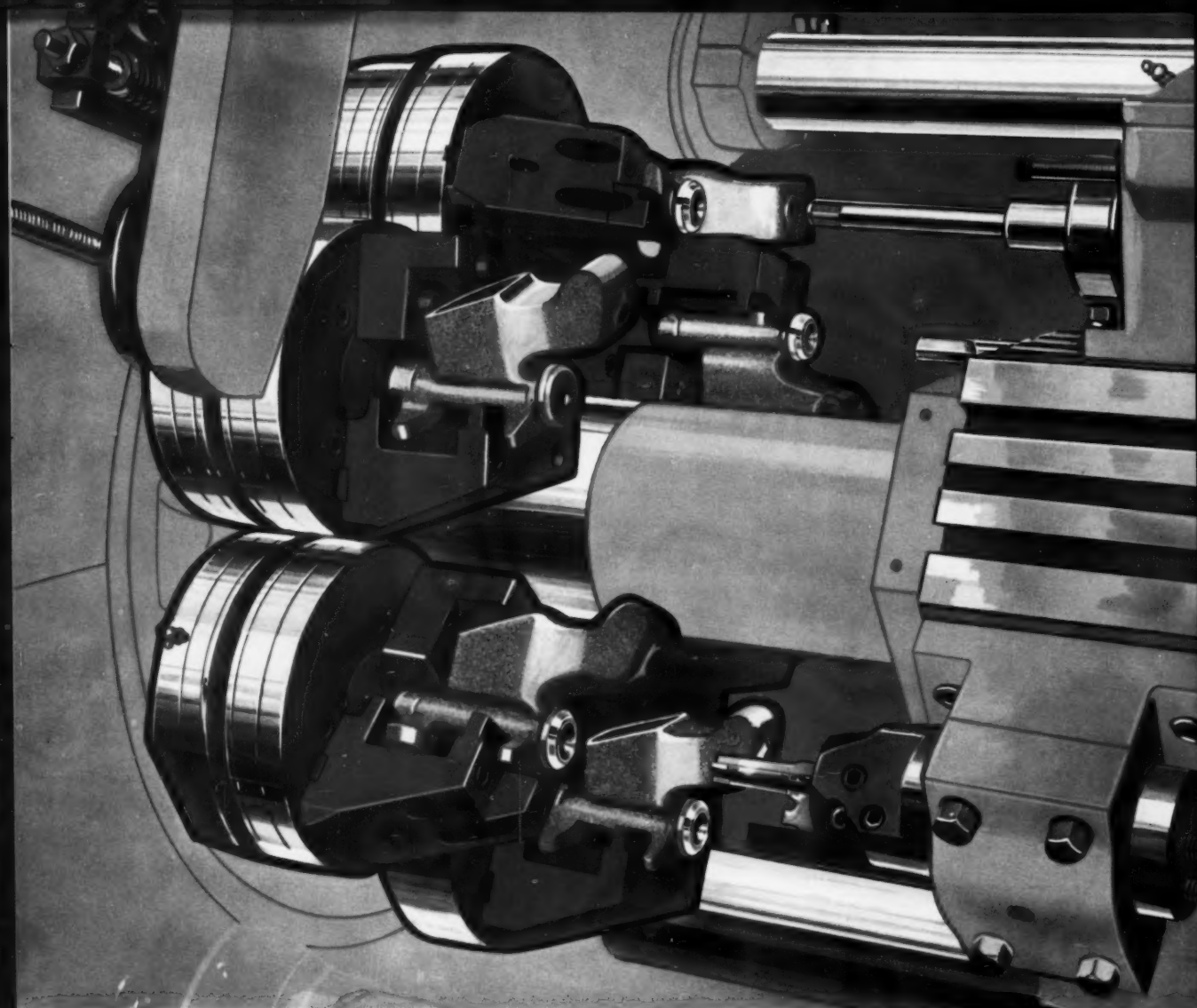
Speed is only part of the story on New Britain's completely new line of four-, six-, and eight-spindle bar machines. Guaranteed accuracy, production run after production run, year in, year out, helps round out the story. If you haven't seen any of the new series in action—six models in all—you owe it to yourself and the profitable productivity of your plant to arrange for a demonstration. All of the exclusive New Britain features you are probably familiar with have been retained and improved. New features unavailable on any other machines have been added. The result—the finest high speed bar turning units on the market. Your New Britain



representative is the man to see. He can show you applications, parts production case histories, show you to fractions of seconds and pennies why new New Britain bar machines are an investment in greater profits with every piece they produce.

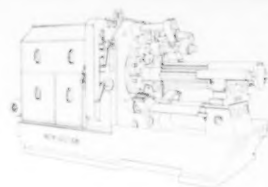
Model	Spindles	Cross Slides	Spindle Speeds	Spindle Capacity	H.P.
450	4	4	41-621	5 $\frac{1}{8}$ "	30-50
52	6	6	271-4250	1 $\frac{1}{4}$ "	15-25
62	6	6	177-2519	1 $\frac{1}{8}$ "	15-30
62	6	6	177-2519	2 $\frac{1}{4}$ "	20-30
635	6	6	63-630	3 $\frac{1}{2}$ "	30-50
826	8	6	98-1481	2 $\frac{3}{8}$ "	30-50

THE NEW BRITAIN MACHINE COMPANY
New Britain-Gridley Machine Division ♦ New Britain, Connecticut



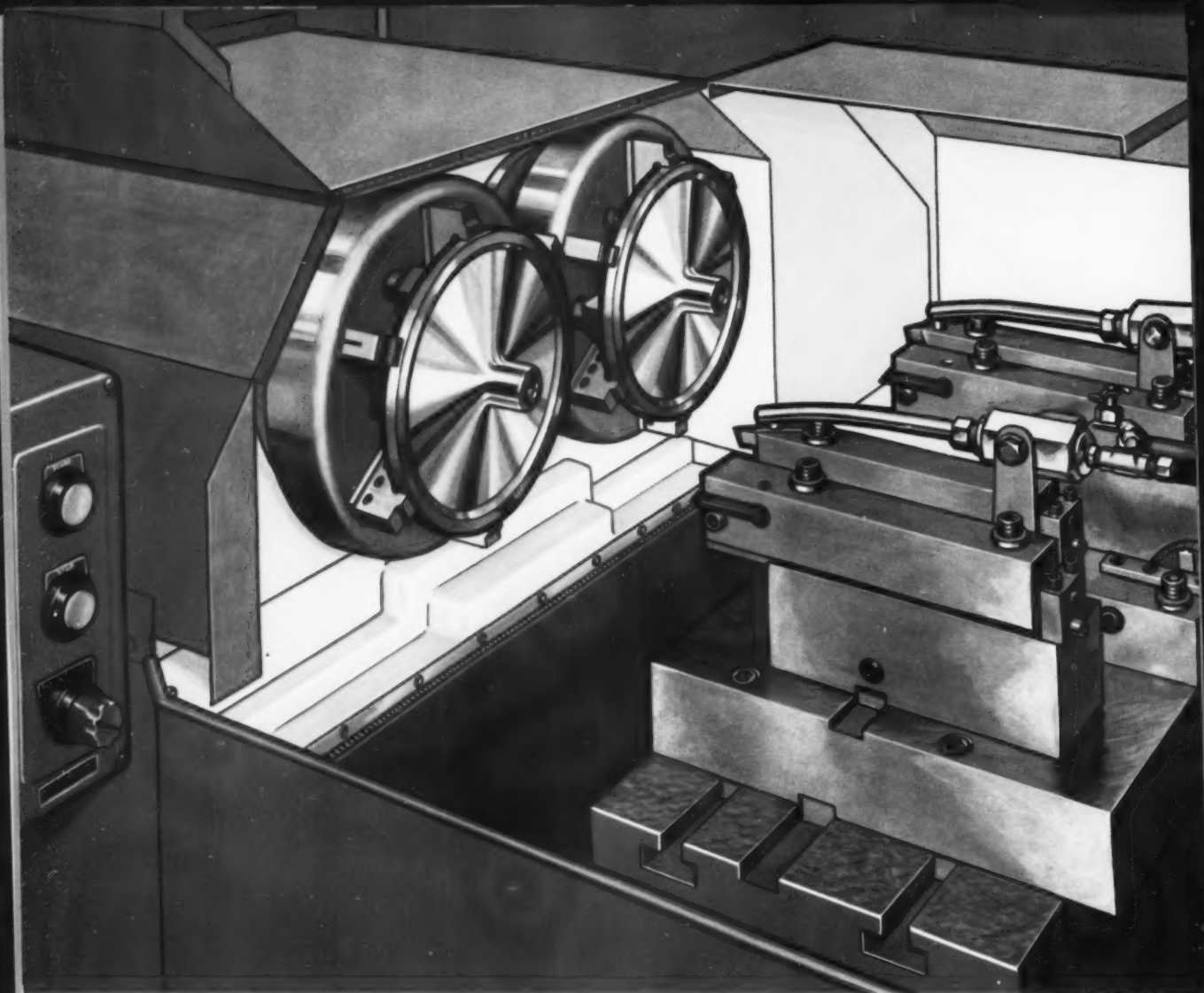
Odd shapes no problem on *New Britain Chuckers*

The peculiar problems presented by odd shaped pieces are frequently as varied as the pieces themselves. The cut may be simple enough but the how and wherefore of chucking and swinging the piece may be something else again. New Britain Chuckers can handle the widest possible range of pieces—even odd shaped work. Open-end design which allows wide open accessibility to the tooling area makes the work easier to chuck, and easier to watch during the machining cycle. Because the work area is more open, this kind of work is easier to swing



on a New Britain. This is one of many extras that are built into New Britain Chuckers. Another basic New Britain difference that pays off handsomely is the exclusive forming arm design which allows for the greatest possible variety of side cuts without special set-up. The combinations of end-working and forming cuts possible are practically unlimited. This flexibility of tooling coupled with big capacity lets New Britain users perform the widest possible variety of chucking machine work. Why not call in your New Britain representative?

THE NEW BRITAIN MACHINE COMPANY
New Britain-Gridley Machine Division • New Britain, Connecticut



New Britain cam actuated *boring and contour turning*



Extreme accuracy, high productivity—even on complex contoured surfaces—these are the areas where New Britain's Vertical and Horizontal Precision Contour Turning and Boring Machines take the kinks out of production. Tool slides are cam actuated, generating contoured and straight surfaces, including sharp corners and exact radii. Time consuming wheel forming and dressing required by some methods of producing close tolerance, fine finish work are eliminated.

This is basic with New Britain and is a good part of the reason for the unbeatable repetitive accuracy of these machines. Both verticals and horizontals

are simple to operate and simple in operating principle. Normally, gaging one dimension is sufficient. From one to four high speed spindles can be mounted on a single machine.

The widely accepted horizontals, or the completely new and revolutionary verticals with exclusive cam-in-head design, can be seen in action simply by contacting your New Britain representative. Whether you require one machine, several machines, the best approach to a building-block set-up, or whatever your precision contour turning or boring requirement may be, check with New Britain before you decide.

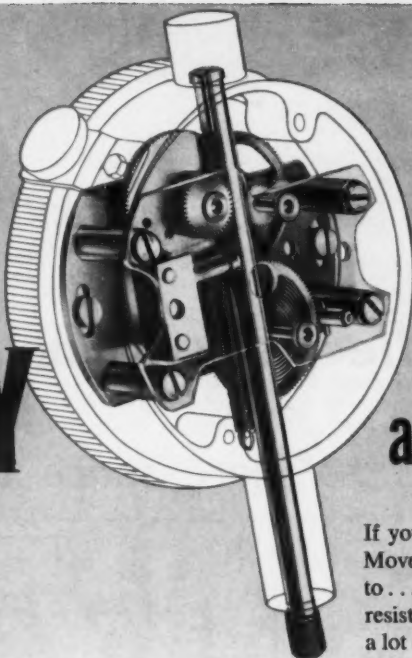
THE NEW BRITAIN MACHINE COMPANY
New Britain-Gridley Machine Division ♦ New Britain, Connecticut

ALL VERY HAPPY

WITH THE



DIAL INDICATOR



and You'll be, too!

If you haven't yet discovered the Federal Miracle Movement Indicator, you have a lot to look forward to . . . as these users point out below. Its *unmatched* resistance to wear and to shock is saving money for a lot of people. Why not join them and enjoy better results than with the indicator you are now using? You will, . . . take *their* word for it!

Drastically Reduced Maintenance Costs

"We have been ordering Federal Miracle Movement Indicators for some time now, and estimate that they comprise about 50% of all the Federal Dial Indicators we have in use at the present time. Our maintenance records show, however, that the Miracle Movement Indicators comprise less than 4.3% of those needing repair. This certainly indicates an outstanding increase in the durability of your product."

The American Welding & Manufacturing Co., Warren, Ohio

Outlasts Them All

"One of our inspection jobs . . . checking the split line height of sleeve bearings . . . is a tough application for the dial indicators because they are mounted on a hydraulic ram and are subjected to heavy impact each time the ram is actuated. Federal Miracle Movement Indicators are doing this difficult job very satisfactorily

at an average maintenance cost of approximately \$3.00 per indicator of which only 10% is for replacement parts! With other makes, repair costs usually run about 6 or 7 times as much per indicator."

McQuay-Norris Manufacturing Co.
Indianapolis, Indiana

Greater Accuracy for OEM Products

Hunter Spring Co. of Lansdale, Pa., has been using Federal Dial Indicators in their testers for many years. Because of the critical nature of the application, they had always made extensive tests and inspections of the indicators to assure the high level of performance required. The increased wear resistance and shock resistance of Miracle Movement Indicators, plus their reduced friction, has made it possible for Hunter to save on inspection costs prior to assembly of the indicator into their equipment.

Best part is...

You don't have to pay a premium price for Miracle Movement Indicators. They actually **COST LESS** than other recognized makes.

You don't have to specify Miracle Movement — just specify Federal! Ask for our latest Dial Indicator Catalog.

Federal Products Corp.

11110 Eddy Street, Providence 1, R. I.

Ask **FEDERAL**® *First*

for Recommendations in Modern Gages . . . Dial Indicating, Air, Electric, or Electronic — for Inspecting, Measuring, Sorting, or Automation Gaging


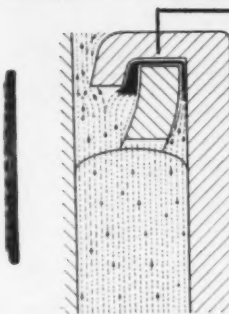
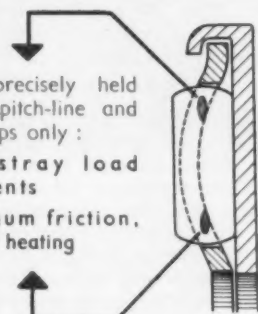
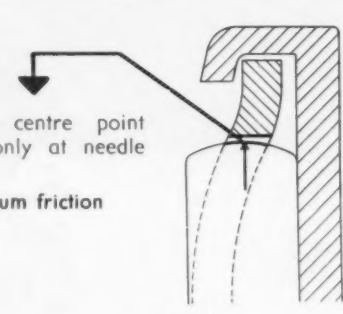
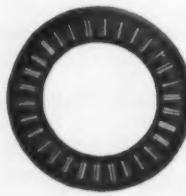
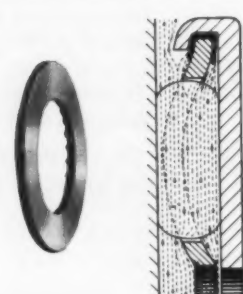
A product of



engineering skill

The new Needle Roller Thrust Bearing

Takes no more space than a washer

 <p>Incorporated race Positive needle retention : — easy mounting</p> <p>Rugged one-piece retainer: — Robust construction — Precision quality</p>	 <p>Accurate, well-lubricated surfaces give positive retainer centring :</p> <p>— No wear of shafts and housings (even where not hardened)</p> <p>— No overheating</p>
 <p>Needles precisely held on their pitch-line and by their tips only :</p> <p>— No stray load components</p> <p>— Minimum friction, wear and heating</p>	 <p>Pivot-like centre point contact only at needle ends :</p> <p>— Minimum friction</p>
 <p>Larger number of needle rollers: — Maximum load capacity — Maximum resistance to load surges</p>	 <p>Generous lubricant feed to contact faces : Lubricant cannot wipe off, no dry running friction :</p> <p>— Suitable for grease lubrication</p> <p>— High speeds without heating or wear</p>

ACTA 2011.B

S.A. des Roulements à Aiguilles NADELLA

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P.O.B. 27 - Phone. : 967-10.15 (+) - Cable : GUILLAROU-PARIS

in machine design or modernization...

Fawick
FSPA
improves
machine
performance

...with increased production through higher machine speed

Fawick Standardized Press Applications may be used as original equipment or for modernization on power presses and other machinery where productivity depends on cycling speed. Instant air clutch action and fail-safe braking allow faster operation without sacrificing safety or precision.

...precision control

FSPA provides split-second starts and stops that assure accurate automatic control of single, continuous or inching operations.

...manpower and machine protection

FSPA eliminates damaging backlash, providing maximum protection for intricate tooling. The spring-applied brake engages immediately in case of air or power failure, preventing costly jamming and insuring operator safety.

...installation flexibility

FSPA can be installed quickly and easily in both OEM and user applications. The package unit may be mounted on a common drum as shown below, or the brake may be mounted at another location on the shaft. Installation can be made with only minimum preparatory work.

...and unmatched low maintenance

Fawick drum-type air clutches have few moving parts and require no lubrication. The self-adjusting 360° friction surface insures long friction life and continuous new unit performance under the most demanding conditions.

FAWICK STANDARDIZED PRESS APPLICATION includes constricting type CB Airflex Clutch, spring-applied CS Brake, Timing Rotorseal and high-speed clutch control — designed into a package unit which meets the toughest requirements for fast, accurate power transmission. FSPA is produced in 26 standard sizes with torque capacities from 2,040 to 172,000 in.-lbs. at 75 psi.



For complete information on how Fawick can simplify your clutch problem, contact your nearest Fawick representative or the Home Office.

FAWICK AIRFLEX DIVISION
FAWICK CORPORATION

9919 CLINTON ROAD • CLEVELAND 11, OHIO
Fawick Canada, Ltd., 60 Front St., West, Toronto, Ont., Canada

MACHINERY, October, 1961

 **FAWICK**
AIRFLEX
INDUSTRIAL CLUTCHES AND BRAKES

For more data, circle this page number on Readers' Service Card.



The Friden Flexowriter: Machine Tool's Machine Tool

At the recent Machine Tool Exposition, approximately 80% of the numerically controlled tools on display featured 8-channel punched paper tape input.

The toolmakers have shown this overwhelming preference for punched paper tape for several reasons:

- 1) the tapes are easy to prepare,
- 2) the coding is visible,
- 3) tape can't get out of sequence,
- 4) tape is durable and unaffected by chance exposure to magnetic fields.

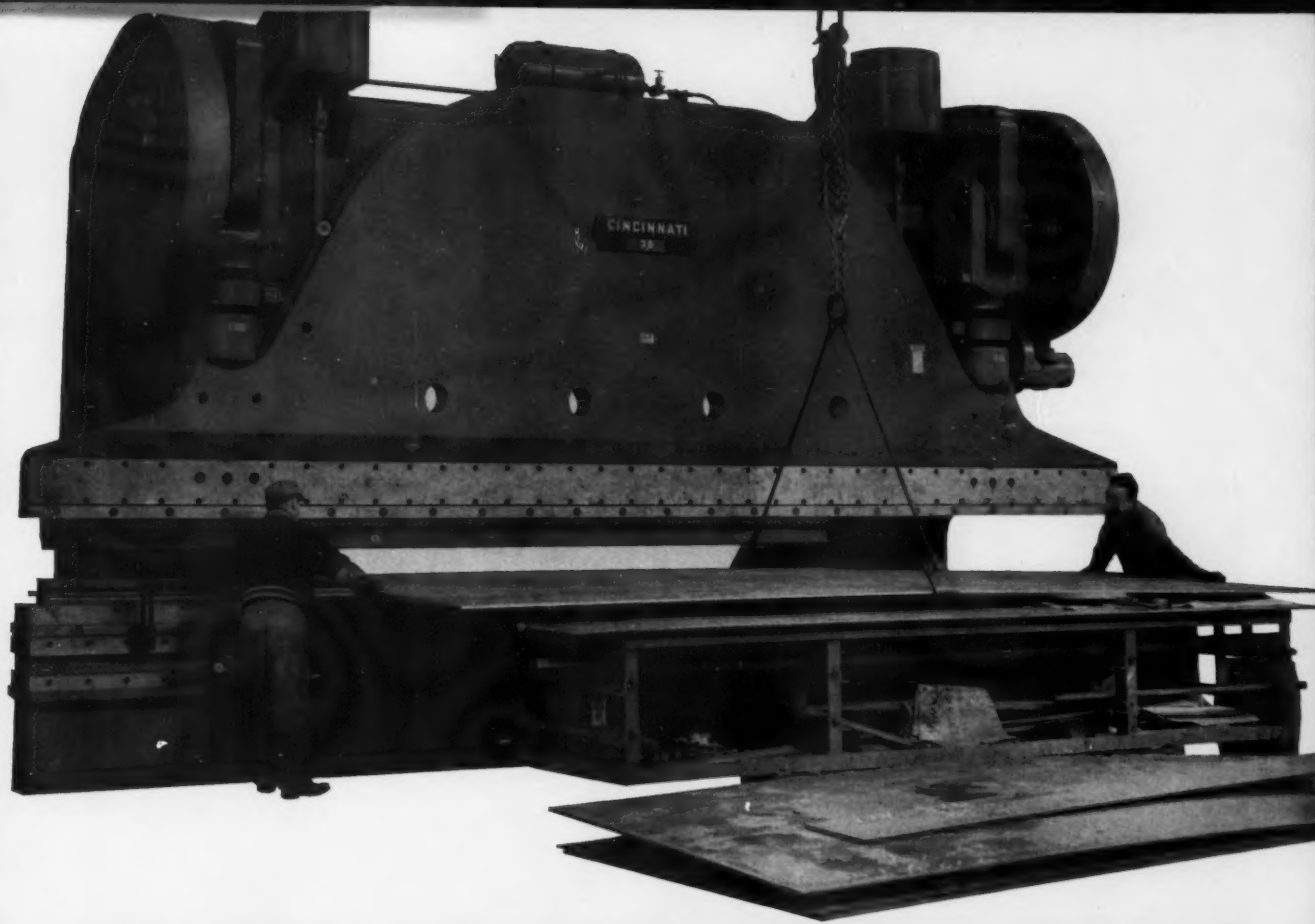
By standardizing on paper tape input for your numerically controlled tools, you get all the benefits listed above, plus one more: It's so much easier (and less expensive) when all of your numerically controlled tools can be

programmed on one device. That device? The Friden NC-1 Flexowriter—the machine tool's machine tool.

THIS IS PRACTIMATION: Friden is the world leader in tape technology and the practical application of the automation it makes possible. For full information, call your local Friden Systems Representative. Or write: Friden, Inc., San Leandro, California. © 1961, FRIDEN, INC.

 **Frident**

Sales, Service and Instruction Throughout the U.S. and World



CINCINNATI® PRESS BRAKE gets new business

Bigger jobs, fewer welded seams, less handling, and easier operation—McGregor-Michigan Corporation gets all four advantages from this 36 Series Cincinnati Press Brake.

As a result, "this new brake . . . helps us be more competitive with some of the larger shops," says R. Hilprecht, sales manager of this steel plate fabricating shop.

This is another example of the way Cincinnati Press Brakes and Cincinnati Shears are reducing costs and opening up new business for shops across the country. If you don't have the new catalogs on these machines, both mechanical and hydraulic, please write for them.

MACHINERY, October, 1961

Shapers / Shears / Press Brakes

THE **CINCINNATI**
SHAPER co.



Cincinnati 11, Ohio, U.S.A.

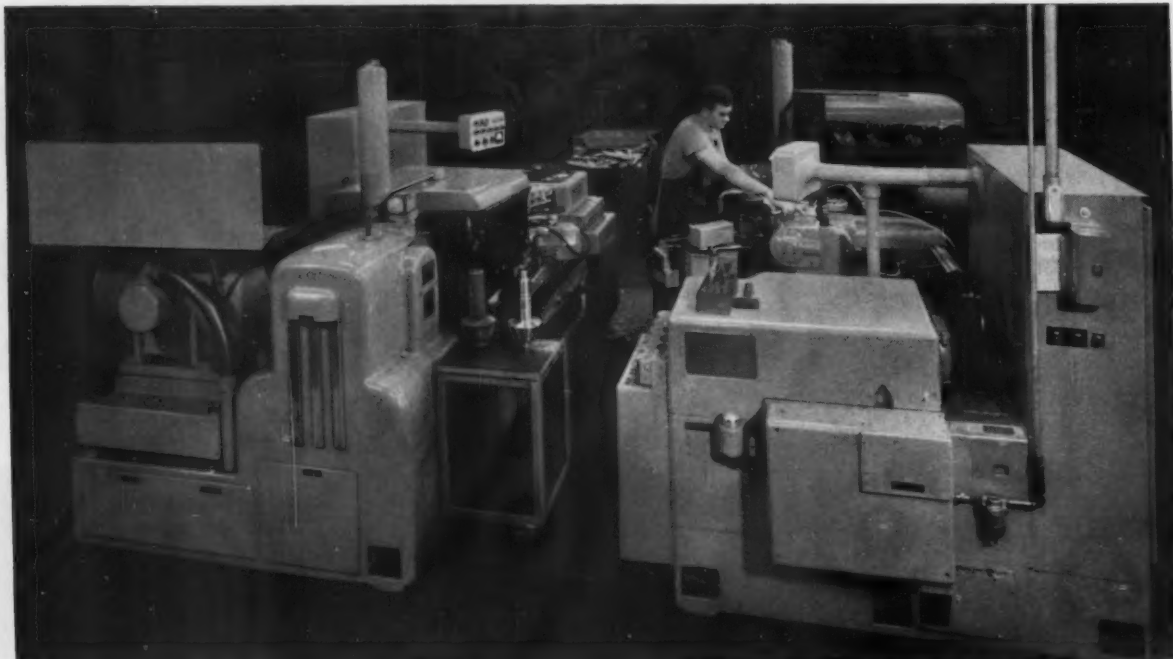
United Kingdom: The Cincinnati Shaper Co., Ltd., Glasgow, Scotland

For more data, circle this page number on Readers' Service Card.

Reduce costs with multi-cycle turning on Monarch 21-H Mona-Matic production Lathes

... get greater accuracy and versatility as a bonus!

The two Model 21-H Mona-Matics shown below are turning bevel drive pinions. They replaced four outdated production lathes. In the same plant, on the steering knuckle line, two additional Mona-Matics replaced six old profit-stealers.



Cost reduction, based on the Mona-Matic method, stems from these user benefits.

- **Increased Output.** Automatic multi-cut turning cycle; one man easily operates two machines.
- **Less Setup Time.** Template controlled, single point, running tool permits setup often in less than thirty minutes; tool change in several minutes.
- **Lower Tooling Costs.** Standard cutting tools used; no expensive forming tools or multiple tool setups.
- **Greater Accuracy.** "Air-Gage Tracer" template control eliminates human element; minimizes work deflection.
- **Time Saved on Succeeding Operations.** Grinding and polishing often eliminated; thread rolling sometimes accomplished during cycle.

The Model 21-H Mona-Matic is a powerful, dependable, production lathe backed by all the accumulated know-how of Monarch engineers. Why not ask us to prove its merits on *your parts*. Write THE MONARCH MACHINE TOOL COMPANY, Sidney, Ohio.



ASK ABOUT THE MONARCH DEFERRED PAYMENT AND TOOL LEASE PLANS

*use Airpower—not Manpower**

CUSHMAN

AIR OPERATED CHUCKS AND CYLINDERS

* Cushman Air Operated Chucks speed production and improve product quality, eliminate fatiguing hand wrenching, plus related rejects and accidents.



SOLD THROUGH
INDUSTRIAL DISTRIBUTORS

TCS61



Cushman also manufactures manually operated chucks, power wrenches, and face plate jaws.

THE CUSHMAN CHUCK COMPANY • HARTFORD 2, CONNECTICUT

New **ARMSTRONG** "90" SERIES RATCHET

**The ONLY Ratchet with
ALL these important features!**



- ① Slenderized head
- ② Thumb-operated reversing lever specially designed so it won't come off
- ③ Reversing-lever stop (Ball-and-spring prevents accidental shifting)
- ④ Simple to clean—only tool required is a Phillips screwdriver (wearable parts may be individually replaced)
- ⑤ Thin handle with knurled grip

- ⑥ Hole in handle for convenient hanging
- ⑦ Fine-toothed gear
- ⑧ Easy ratcheting action
- ⑨ 1/4\", 3/8\", and 1/2\" square drives (two handle lengths in 1/2\" drive)

All wearable parts of ARMSTRONG Ratchets can be replaced individually, inexpensively, and easily. Entire ratchet handles need not be replaced in the event of tooth wear, as is necessary with ratchets in which the teeth are formed in the head of the handle.

* The name ARMSTRONG on these fine tools is your assurance of highest quality. Manufactured under strict quality control, all ARMSTRONG Tools can be used with confidence.

Extra heavy duty "50" Series ARMSTRONG ratchets (illustrated at right) are manufactured in 1\", 3/4\", 1/2\", and 3/8\" square drive sizes. For complete information on these, as well as the approximately 5500 other tools in the ARMSTRONG Line, see General Catalog #700. Your local ARMSTRONG Distributor can supply you with Catalog #700 and can show you the new "90" Series Ratchets. If you do not know who handles the ARMSTRONG Line in your area, we will be glad to furnish this information upon your request.



ARMSTRONG BROS. TOOL CO.

5213 W. ARMSTRONG AVE. • CHICAGO 46, ILLINOIS





SKINNER provides
custom flexibility
in standard
solenoid valves



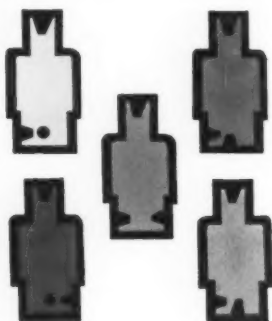
Versatile, top quality V5, X5 line offers wide range of options

Skinner's two-way and three-way V5, X5 series of solenoid valves has earned the description—"The Universal Line." With more than 100,000 variations possible, V5, X5 valves are available for every conceivable application. And top quality is emphasized with bubbletight sealing, and stainless steel body, plunger and sleeve assembly. Precision machining, unique welding techniques, specially designed and developed machinery and manufacturing methods are all used by Skinner to produce the best valves made. These valves are small, yet handle operating pressures as high as 3000 psi. They accommodate all media that do not corrode stainless steel. And no other solenoid valves offer so many optional features. Check the following options.



FLOW CONTROL

Precise, accurate control of media flow is possible with all Skinner V5, X5 valves. Both two-way and three-way valves are available with adjustable flow in the main stream, and with manual override. Two-way valves are also available with adjustable bypass. Exhaust flow can be controlled in three-way valves.



PORTING

Restrictions of installation or application, and mounting are minimized because Skinner provides a wide variety of port location options. V5, X5 valves are available with ports at right or left angles, on bottom, top, and sides for virtually all combinations of flow.



COILS

Skinner V5, X5 valves are available with coils of many types for most DC and AC voltages at 25, 50 and 60 cycle frequencies. Whether your requirements are for continuous or intermittent performance, in tropical, high moisture or high temperature environments, or for dual voltage, Skinner UL approved coils are available with leads of several types and lengths.

ELECTRICAL HOUSINGS

Skinner offers an electrical housing for any application. Some of the most common are:

- standard $\frac{1}{2}$ " NPT conduit
- grommet outlet
- single or double automotive terminals
- JIC housings with integral junction box
- AN connector for military applications
- strain relief connector for quick disconnect

All housings are steel, plated for wear and appearance, and can be rotated 360° for easy installation.

MOUNTING

Skinner V5, X5 valves are provided with tapped holes for normal mounting, with mounting brackets for panel or other surface, or with flange for direct mounting without threaded pipe connections.

The Skinner V5, X5 series of two-way and three-way solenoid valves provides top quality design with orifices from $\frac{1}{32}$ " to $\frac{3}{8}$ " diameter, normally open, normally closed, dual purpose, directional control and multi-purpose, in standard and explosion-proof construction. Also included in this line is a three-way quick-exhaust type which is designed with an additional port to exhaust cylinders 4 times faster than standard types.



• • •

Typical applications—machine tools, cylinder control, instrumentation and automation of all kinds, laundry equipment, aircraft and missiles, etc. For catalogs and complete information contact a Skinner Distributor listed in the Yellow Pages or write us at the address below.

When you specify solenoid valves, specify Skinner. Skinner solenoid valves are distributed internationally.



SKINNER ELECTRIC VALVES

SKINNER ELECTRIC VALVE DIVISION,
THE SKINNER CHUCK COMPANY • NEW BRITAIN, CONNECTICUT, U.S.A.

PRINTED IN U.S.A.



for Strength
... Economy
... Versatility

Tool Steel Topics



Die of AH-5 Tool Steel Forms Sheet Steel Auto Frames

This huge die, of Bethlehem AH-5 tool steel, was made by Parish Pressed Steel Division of Dana Corporation to form automobile frames. Hardened to Rockwell C 60-62, the die handles sheet steel .120 in. thick.

Engineers at Parish like the wear-resistance of AH-5, which enables them to produce about 25,000 frames before slight redressing of the die becomes necessary. AH-5's low distortion and good shock-resistance were also singled out for favorable comment.



AH-5 is an air-hardening grade containing 5 pct chromium. It's an easy steel to machine because it can be annealed to 212 Brinell. Here's its typical analysis:

Carbon 1.00	Chromium 5.25
Manganese 0.60	Molybdenum 1.10
	Vanadium 0.25

AH-5 assures economical, long-run performance from forming and blanking tools, dies, and punches. For full particulars about AH-5 or any of our other air-hardening tool steels, get in touch with your Bethlehem distributor.

For maximum wear use LEHIGH H

A maker of beer can openers produced several million pieces with die of Lehigh H (our AISI D-2 grade). Lehigh H provides outstanding wear-resistance in a variety of difficult applications because of its high concentration of well-distributed carbides.

It's also easy to machine. An air-hardening grade, Lehigh H has a high-carbon, high-chrome analysis.

BETHLEHEM TOOL STEEL ENGINEER SAYS:



Here Are the Facts on Clearance:

**It's the Blank That
Tells the Story**

Operators of punching, blanking, and shearing equipment recognize that proper clearance between punch and die is necessary for good operation. The right amount of clearance produces the lowest cutting pressure and the least wear on the tools, and also makes possible clean, sheared edges which are free from burrs.

The most common rule for clearance is this: clearance should be about one-tenth the stock thickness. Yet in many shops there's a continual search for some "magic" formula that will more accurately determine the proper clearance . . . which in turn will automatically eliminate whatever type of trouble is current.

There is no need to wait for such a formula to be developed because it is not actually needed. Examination and evaluation of the blanks, or sheared edges being produced, will tell whether the proper clearance is being used. Sheared edges produced with proper clearance will show "shear" (the smooth, shiny portion) for about 1/5 to 1/3 the stock thickness; the remainder of the edge will show "fracture" (this is the rough, granular part). If the "shear" occupies too great a portion of the thickness, it indicates the clearance is too great; when the "shear" is too little, insufficient clearance is indicated. If heavy burrs are present on the sheared edges, and if the blanks are "cupped," then the clearance is too great. Burrs on portions of the sheared edges may indicate misalignment or dull tool edges which, in effect, change the clearance from the amount theoretically present.

Developing and maintaining proper clearance pays off in the production of high quality parts, and also results in minimum tool wear and low tool costs.

This well-known manufacturer depends on . . .
A BANK OF THOMPSON GRINDERS
. . . for a tough production job.



THOMPSON RAMO WOOLDRIDGE INC. picks
Thompson Grinders for accuracy,
dependability and speed.

All the Thompson machines shown above in one bank are grinding jet aircraft engine compressor vanes. Each of the 5 surfaces on the root end as well as the concave and convex airfoil surfaces on the lug end are ground to extreme accuracy on the stainless steel forgings.

For the five years that these Thompson machines have been steadily on this job, downtime and maintenance costs have been negligible factors.

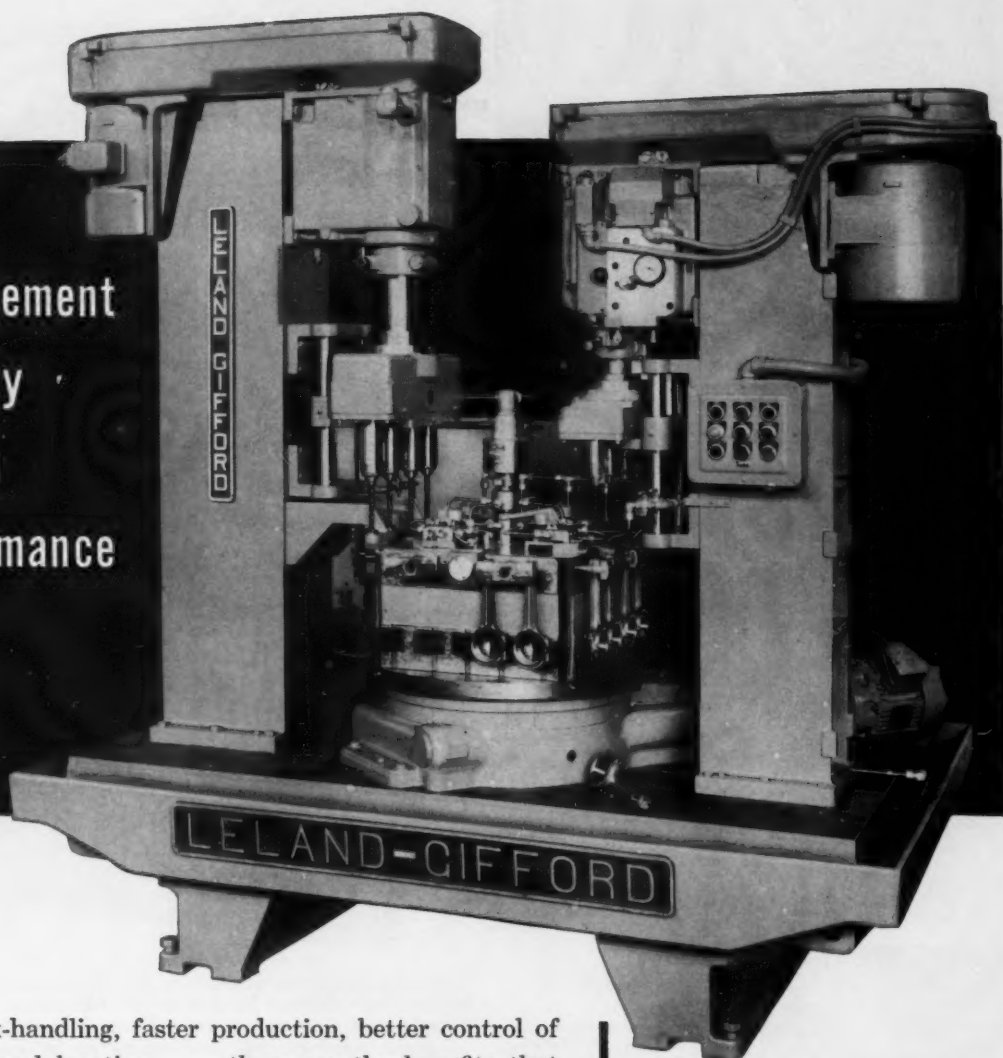
Put your toughest production job on a Thompson grinder and watch it cut your costs, speed your production and improve your product.

THE THOMPSON GRINDER CO. Springfield, Ohio

"Keep Thompson in mind for that daily grind"

Thompson
SURFACE
GRINDERS

your
management
will buy
proven
performance
like
this



Less work-handling, faster production, better control of hole size and location . . . these are the benefits that quickly justify investment in Leland-Gifford special drilling machines. We will gladly work up your rough notes into a fully developed proposal and supply the facts and figures you need to sell management on your suggestions for better precision drilling methods.

***For automatic drilling at its best
be sure to see Leland-Gifford***

CALL THE OFFICE NEAR YOU

LELAND-GIFFORD SPECIAL DRILLING MACHINES

THE JOB: Drill $\frac{1}{8}$ " oil splash hole and $\frac{3}{16}$ " metering hole in connecting rod.

THE MACHINE: A Leland-Gifford two-unit special with one No. 4 and one No. 3 self-contained drilling unit. Index table is loaded with four parts in each station and clamped by hydraulic clamp cylinders. Four-spindle multiple head at left station drills splash holes to depth; directed air jets at rear station clear chips, four-spindle head at right station drills metering holes. Production of 620 pieces per hour is easy at 100% efficiency.

WORCESTER 1, MASSACHUSETTS U. S. A.

Chicago 5
2515 W. Peterson Ave.

Detroit
10429 W. McNichols Rd.

Cleveland 22
P. O. Box 853

Indianapolis 6, P. O. Box 1051
Rochester 12, P. O. Box 24, Charlotte Station

New York Office
75 S. Orange Ave.
South Orange, N.J.

Los Angeles Office
2620 Leonis Blvd.
Vernon 58, Cal.

"The One Machine We Couldn't Do Without"

COPING AND MITERING HEAVY STRUCTURAL SHAPE

18" Beam (above) is held between vises for the short cut. On the long cut (left) vises were removed and beam held by simple clamp. The MARVEL Band Saw is truly indispensable in ornamental and structural iron shops where this type of work is done daily. The machine will cut-off square, miter and cope any work shape from the smallest moulding to 18" I-beams.

SPLITTING CLAMP RINGS, BUSHINGS

Splitting clamp rings, connecting rods, bushings and collets is a fast, simple operation on the No. 8 Band Saw. Perfect control, quick chucking facilities, accuracy and speed are features that especially fit the machine to handle this type of work.



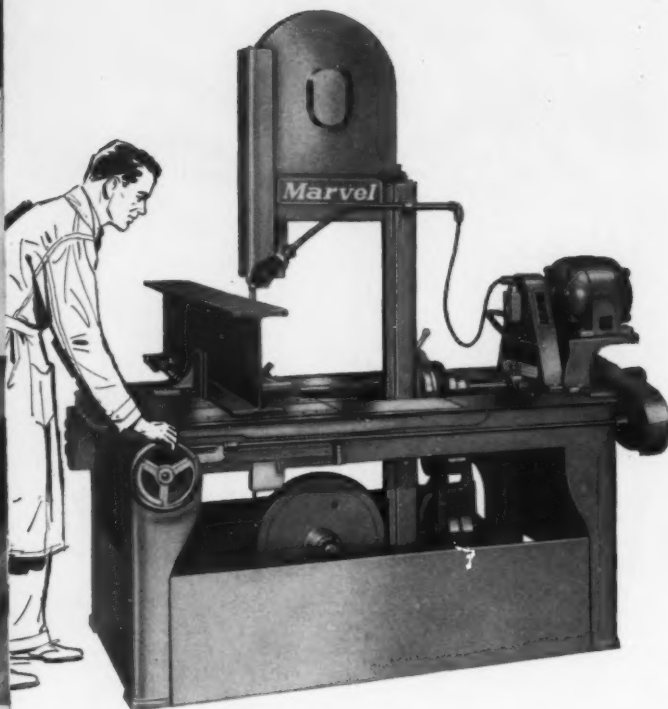
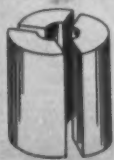
MITERING LARGE DIAMETER PIPE

Pipe (or any bar shape) may be mitered at a 45° angle without the need for special jigs or fixtures. Even when cutting miters, work remains in the same position as it does for straight cuts. Column and blade are instantly tilted to desired angle, even without stopping the machine. Perfect miters (or lesser angles) are sawed without any layout or special equipment.



SEGMENTING LARGE DIE BLOCK

Three equally spaced re-entrant cuts were made in this 16" x 18" SAE 4130 Forging. Job was completed, floor-to-floor in 5 hours. No special jigs or fixtures were required. An unusual job that serves to emphasize the versatility of the MARVEL No. 8 Saw.



"As simple to use and handy as a Scout Knife" is the way another user described his MARVEL No. 8 Universal Band Saw recently . . . and we can't think of a better way to describe this versatile metal cutting machine.

With a MARVEL No. 8 Band Saw, you can do almost any conceivable straight, angle, or miter metal sawing job—from cutting-off bar stock to making the most unusual forming cuts. You can handle small, delicate work, and in the next minute, saw structurals, or segment large work as illustrated in the lower photograph. You will save time, labor, and material with a MARVEL No. 8 Band Saw because no other saw has all the features to be had in this truly universal tool.

Upright column design and forward travel of the blade through the work (which remains stationary on the table-height saw bed) provides easy, unobstructed visibility and more convenient and efficient working conditions; column can be tilted and locked at any angle up to 45° left and right of vertical; the exclusive MARVEL Power Feed with Automatic Overload Relief; Automatic cutting-depth stops; simple, convenient operating controls—these are some of the features which make the No. 8 Band Saw the most useful—and used—metal cutting saw on the market.

For the complete story, ask or write for Bulletin 875 which illustrates and describes MARVEL Universal Metal Cutting Band Saws.



ARMSTRONG-BLUM MFG. CO. 5700 N. BLOOMINGDALE AVE. • CHICAGO 39, ILL.



ECONOMICALLY: *(No difference between tape and these tools for automatic chucks)*

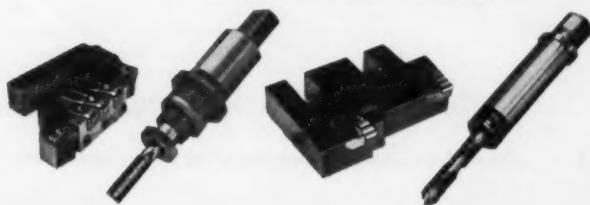
These new tools can cut your change-over time on automatic chucks 50 to 75%. They provide the same **ECONOMIC** benefits as numerical control. Setup procedures and dimensions are programed on layout drawings. All cutting tools are preset accurately in bench gages while your machine is running. The first piece produced after setting up is an accurate one. The toolholders are clamped or chucked in the machine hydraulically. Job information is "stored" in layout drawings. Repeat jobs can be set up and running in 30 minutes. This means it is now economical to put short-run jobs on automatics—reduce your lead time and parts inventory. Inventory—the magic word in cost cutting. **ANNUAL COST** of inventory is 18 to 25% of its value. So if you produce a lot of different parts on turret lathes and single-spindle chucks, here's a proved new method of saving money.

Scully-Jones and Company

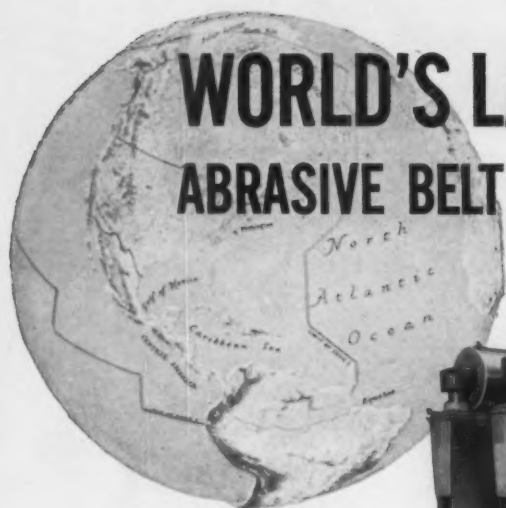
1906 South Rockwell Street, Chicago 8, Illinois

**SCULLY
JONES**

**QUICK-CHANGE
QUICK-SET TOOLING**



Tools can be inserted in only two and one-half minutes.



WORLD'S LARGEST MULTIPLE HEAD ABRASIVE BELT GRINDER by Hill Acme Co.

★ *Saves Floor Space*

★ *Reduces
Material Loss*

★ *Equally Efficient
for "Wet" or "Dry" Operation*



HILL ACME multiple head stainless strip grinder partially assembled showing the two-roll heads for endless abrasive belts and the adjustable motorized steel billy rolls for increasing belt pressure against the steel strip. The belt on any head can be changed while others are in operation.



HILL ACME four head grinding and polishing machine for the progressive finishing of stainless steel strip. This unit will process material .010" to .250" thick and 50" wide and produce up to No. 4 finish.

This four head HILL ACME abrasive belt grinding and polishing machine requires only half the floor space of four conventional strip grinders. The flexible design permits the addition of any desired number of heads.

For heavy stock removal "wet" grinding is recommended with 600 GPM coolant. Sludge passes through the bottom of the machine to the filter unit. Tests prove that considerable less coiled material is lost than in previous methods. A built-in oil mist spray system is used in polishing operations. Rubber covered guide rolls, built into the machine, create the proper "break" angle of the strip over each billy roll to flatten the strip at the point of contact with the abrasive belt. The billy rolls are actuated vertically by hydraulic power to overcome the tension on the steel strip.

This unit is the result of thirty years of success in producing endless abrasive belt grinding and polishing machines for all types of ferrous and non-ferrous materials.

Complete details are available.

The HILL ACME Company

Also Manufacturers of:

"HILL" Grinding and Polishing Machines • "ACME" Forging Machines • "CANTON" Rotary and Alligator Shears • BAR-BILLET Shears • MATERIAL HANDLING Equipment • "CLEVELAND" Knives and Shear Blades • KLING Metal Working Tools.



1201 WEST 65th ST., CLEVELAND 2, OHIO

YOU'RE ON THE MONEY WITH **UNIVERSAL** DRILL BUSHINGS



In shop talk you're "on the money" with Universal drill bushings. You're "in the money" with savings, too. Universal drill bushings save tools because they have super finished bores, blended radii and 100% concentricity. They wear longer and are easier to change due to their knurled heads. All standard sizes and lengths available for immediate delivery.

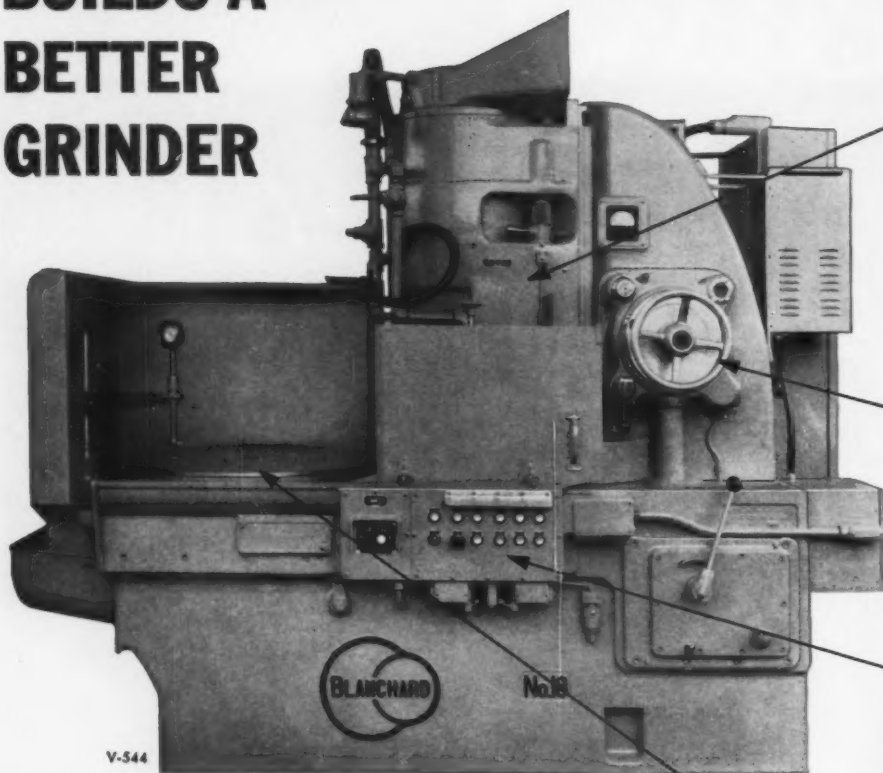


Write today for new catalog showing the complete line of Universal quality products.



UNIVERSAL ENGINEERING COMPANY • FRANKENMUTH 2, MICHIGAN

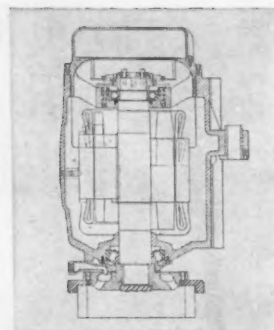
HOW BLANCHARD BUILDS A BETTER GRINDER



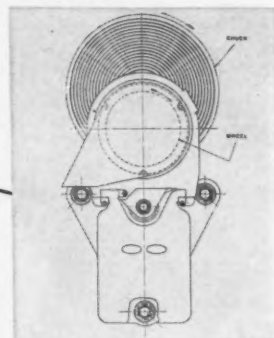
V-544

There's no mystery about the *better* performance you get with a BLANCHARD Surface Grinder. It's simply a matter of *better* design of each individual machine part. For example, look at just 4 features of the No. 18, shown at the right.

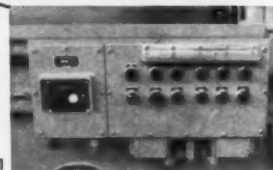
Get complete details on all 24 models of BLANCHARD grinders. They're today's leading high precision, high production grinders on materials ranging from carbon to quartz... from bronze to steel. You can handle parts ranging from tiny jewels to giant plates up to 108" across corners.



SPINDLE... incorporates a superior, pre-loaded anti-friction bearing system that removes all backlash and radial play. Integral "balanced" mounting of rotor on spindle eliminates vibration.



WHEEL HEAD COLUMN... is of heavy box-section design for extra rigidity... supported at 3 widely-spaced points. Column may be easily adjusted for alignment. Special column tilting devices available to produce concave or convex surfaces.



V-541

GRINDER CONTROL... is compact and conveniently located for fatigue-free handling. All control panels are BLANCHARD manufactured for troublefree operation.



W-949

MAGNETIC CHUCK... provides maximum useful magnetic surface... has such closely spaced poles, that work as small as a quarter will always touch two or more.

PUT IT ON THE



THE BLANCHARD MACHINE COMPANY

64 State Street, Cambridge 39, Massachusetts

A STATEMENT FROM



The necessity of maintaining the most efficient manufacturing facilities and the use of MAPI formula

Greenfield Tap & Die Division of United-Greenfield Corporation involved as it is in the highly competitive cutting tool industry, has long recognized the vital necessity of maintaining the most efficient manufacturing facilities obtainable. We have also realized that there must be a sound and consistent approach to the evaluation of proposed replacements whether they are for the realization of greater production efficiency or for the improvement in the quality of our tools.

For many years it has been our policy at Greenfield Tap & Die to invest a considerable amount annually in new and improved equipment. The magnitude of these expenditures naturally requires considerable study and advance planning.

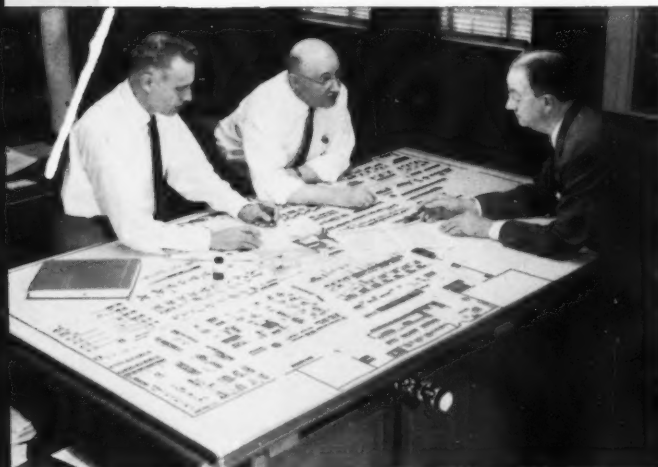
One of the first systematic developments in this area was a three year projection of machinery and equipment replacement revised annually. This is initiated at the factory level by our Works Manager, superintendents and foremen. It provides details for each operating department as to specific equipment which should be replaced together with the reason for the recommendation. This is then reviewed with the General Manager and the budget for the following year determined.

In 1954, after considerable study, it was decided to adopt the MAPI system of determining the economic advisability of replacement of equipment. It was felt that this method provided a systematic and sound approach to such determinations. In our opinion it provided a scientific tool which results in a consistent analysis of the various factors which should be considered in any replacement studies. Through the MAPI formula it is possible to weigh the advantages of labor, fringe benefits, maintenance, supplies, tool costs and other savings against the cost of the capital required. We believe this is far superior to any system of "pay-off period," or "rates of return" or "rule of thumb."

Through the year a MAPI analysis is made up as each piece of equipment is considered for purchase. This is used as a basis of justification of each expenditure recommended on the three year projection. At present we are moving into the more recent developments of MAPI in that we will use Urgency Ratings. The use of MAPI analysis at Greenfield Tap & Die represented a real forward step in progressive management. We believe it has helped us to stay abreast of the rising tide of costs and to continue to offer to industry high quality tools required for today's precision manufacture.

ROBERT S. HARPER

*Vice President and General Manager
Greenfield Tap & Die Division*



Three executives of Greenfield Tap & Die who have been closely concerned with the machine replacement program. Left to right — Robert Dennis, Manufacturing Methods Supervisor; Charles J. Sullivan, Works Manager; Robert E. Lovett, Manager Production Planning.

**Keep gathering metal-working
production ideas . . . be well informed
when you replace machinery**

Rockford Insert Group . .

October, 1961

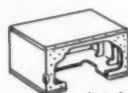
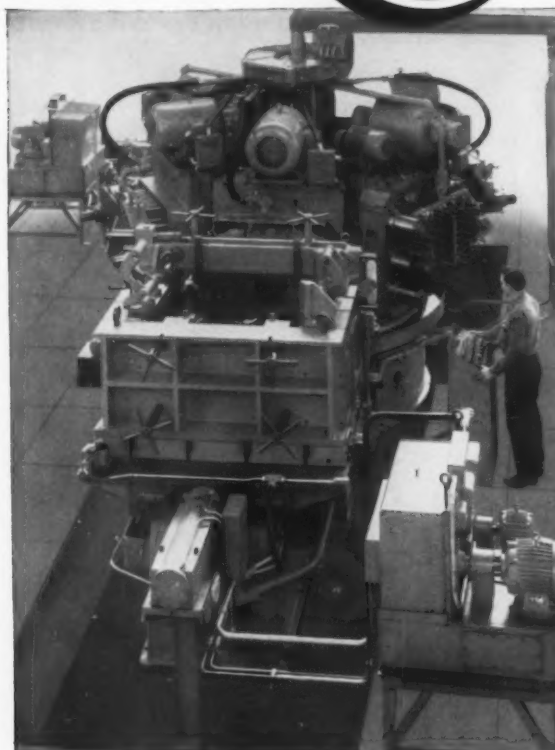
NEW



STANDARD

Versa-Matics

Patents Pending



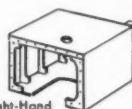
A Left-Hand Steel Case



B Left-Hand Cover



C Right-Hand Cover



D Right-Hand Steel Case

MACHINE No.

1

Standard Barnes "Versa-Matic" with 6-Station Rotary Table and Shuttle-Type Work Holding Fixture. Drills, reams, chamfers, and taps workpieces A, B, C, D, and E.

Approx. Loading Time per piece 3.00 min.

Approx. Unloading Time per piece 2.00 min.

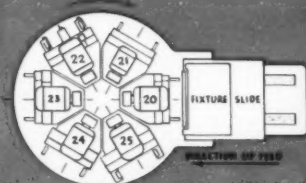
Gross Production (100% efficiency):

Case Parts 6.55 per hr.

Cover Parts 9.50 per hr.

HEAD OPERATIONS

- Unit 20: 28-spindle drilling head
- Unit 21: 28-spindle chamfering, reaming, & counterboring head.
- Unit 22: 27-spindle tapping & milling head
- Unit 23: 35-spindle drilling head
- Unit 24: 28-spindle chamfering, reaming, & counterboring head
- Unit 25: 34-spindle tapping & reaming head



Standard Barnes "Versa-Matic" with Two Five-Station Rotary Tables and Shuttle-Type Work Holding Fixture. Drills, chamfers, reams, and counterbores different surfaces of same workpieces A, D, and E processed on Machine No. 1.

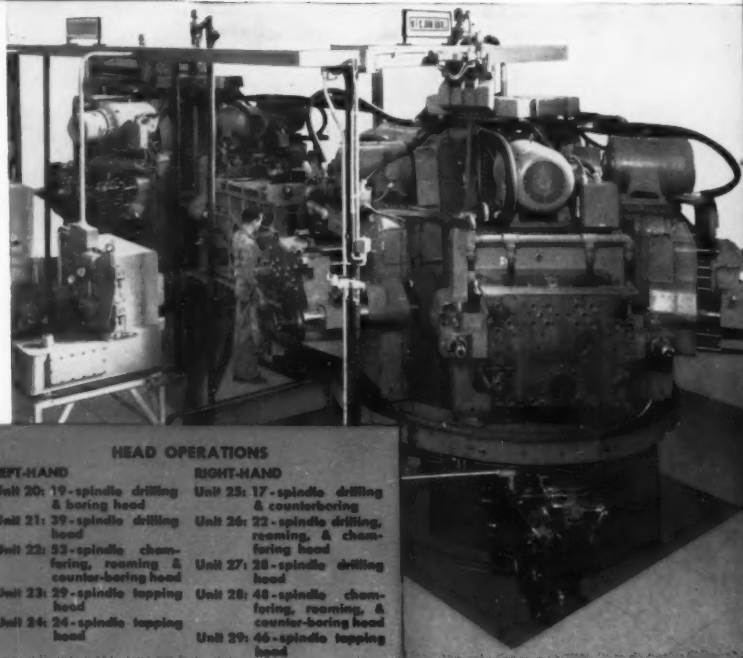
MACHINE No.

2

Approx. Loading Time per piece 3.00 min.

Approx. Unloading Time per piece 2.00 min.

Gross Production (100% efficiency) 2.90 per hr.



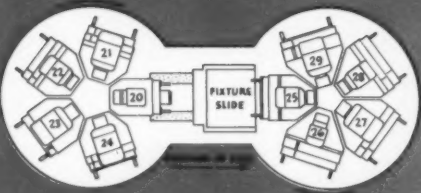
HEAD OPERATIONS

LEFT-HAND

- Unit 20: 19-spindle drilling & boring head
- Unit 21: 39-spindle drilling head
- Unit 22: 53-spindle chamfering, reaming & counter-boring head
- Unit 23: 29-spindle tapping head
- Unit 24: 24-spindle tapping head

RIGHT-HAND

- Unit 25: 17-spindle drilling & counterboring
- Unit 26: 22-spindle drilling, reaming, & chamfering head
- Unit 27: 28-spindle drilling head
- Unit 28: 48-spindle chamfering, reaming, & counter-boring head
- Unit 29: 46-spindle tapping head



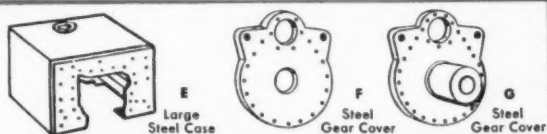
October, 1961

For more data circle No. 876 on Readers' Service Card.

CENTER OF MACHINE-TOOL EXCELLENCE

ROCKFORD, ILLINOIS, U.S.A.

NOW OFFER 3-WAY SAVINGS FOR SMALL LOT MACHINING



Versa-Matic Design Assures Greater Efficiency on Low Production, Conserves Capital Expense and Floor Space

These new W. F. & John Barnes production machines, termed "Versa-Matics," illustrate three basic applications incorporating a new, exclusive principle in machine tool engineering which now makes possible substantial savings in handling a broad range of low production work. They are designed with standard indexing tables mounting multiple-spindle heads, and

are equipped with quick locating fixtures and shuttle-type feed units that move the work to the tools. Electrical contact devices for each station are mounted overhead, and are the self-cleaning type. Contacts are fully interlocked and enclosed when in operation, with remaining contacts de-energized when out of operation. The versatility of these new machines with capacity for handling more than one workpiece, offer three-way savings. For example, for a road equipment manufacturer, machines illustrated provided up to 80% savings in floor space over any other processing method, and reduced equipment cost up to 50%. Handling many operations simultaneously, achieved high efficiency with less work handling. Now, for larger and smaller work, the new Barnes "Versa-Matics" are available in a range of standard sizes to serve your specific production requirement.

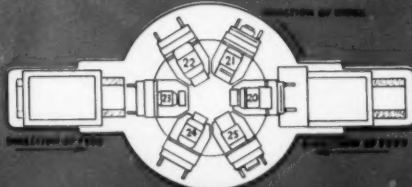
MACHINE No. 3

Standard Barnes "Versa-Matic" with Center 6-Station Rotary Table and Two Shuttle-Type Work Holding Fixtures. Drills, bores, chamfers, and taps same workpieces A, D, and E processed in Machine No. 1 and 2, and also workpieces F and G.

Approx. Loading Time per piece	Case Parts 3.00 min.	Gear Covers 2.00 min.
Approx. Unloading Time.....	2.00 min.	1.00 min.
Gross Production (100% E.)..	4.73 per hr.	5.00 per hr.

HEAD OPERATIONS

- Unit 20: 4-spindle semi-finish boring head
- Unit 21: 4-spindle semi-finish boring head
- Unit 22: 21-spindle drilling head
- Unit 23: 21-spindle chamfering head
- Unit 24: 15-spindle tapping head
- Unit 25: 4-spindle finish-boring head



WRITE FOR MORE DATA

If you have similar small lot work requiring multiple machining operations where competitive costs must be maintained, it will pay you to get full facts today on the new Barnes standard "Versa-Matics." Cost analysis will be gladly rendered without obligation.

**W.F. & JOHN
BARNES**

Builders of
Better Machines
Since 1872

W. F. & JOHN BARNES COMPANY
402 SOUTH WATER STREET • ROCKFORD, ILLINOIS

Multiple Spindle Drilling • Boring • Tapping Machines • Automatic Progress-Thru Transfer-Type Machines

For more data circle No. 876 on Readers' Service Card

October, 1961

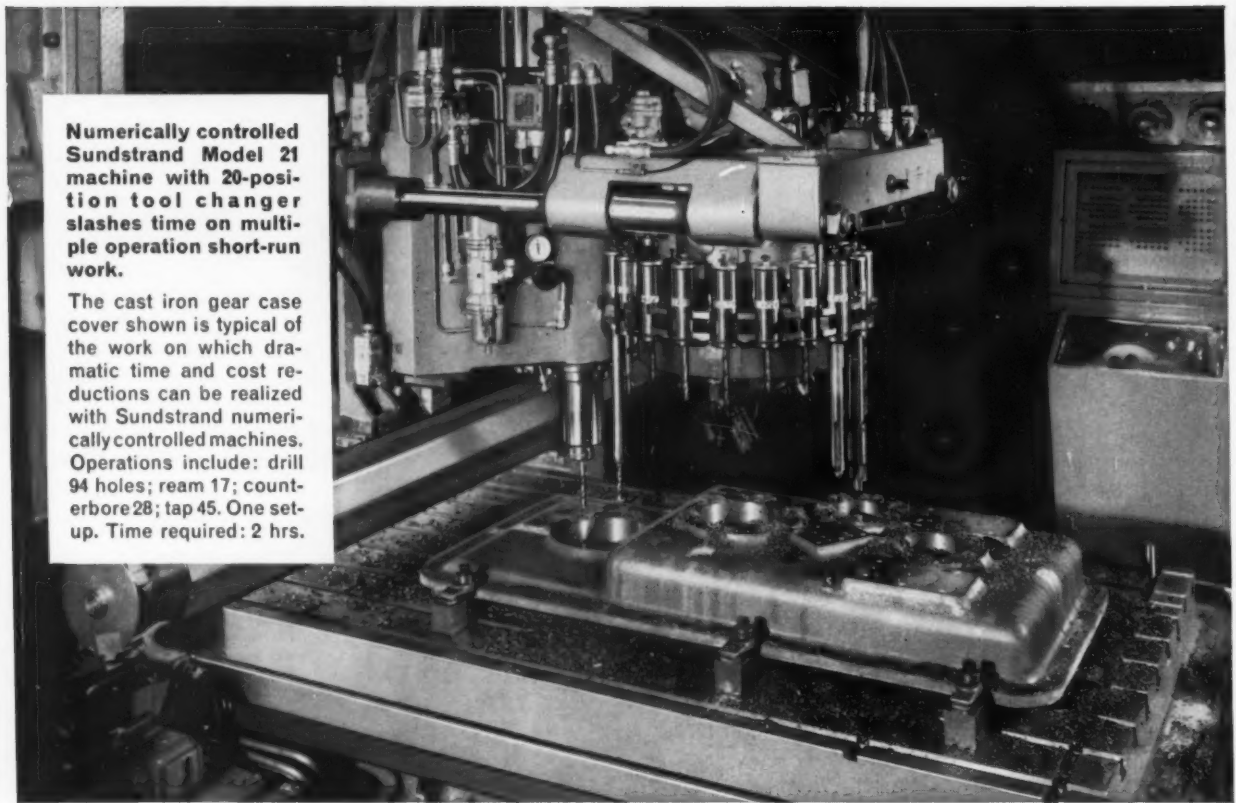
CITY OF MACHINE-TOOL SPECIALISTS **ROCKFORD, ILLINOIS, U.S.A.**



How fast can you machine

Numerically controlled Sundstrand Model 21 machine with 20-position tool changer slashes time on multiple operation short-run work.

The cast iron gear case cover shown is typical of the work on which dramatic time and cost reductions can be realized with Sundstrand numerically controlled machines. Operations include: drill 94 holes; ream 17; counterbore 28; tap 45. One setup. Time required: 2 hrs.



See what you can save with Sundstrand NC machine tools

The cost reduction potential of Sundstrand numerically controlled machines can be measured in terms of both direct *and* indirect savings.

Faster production comes from programed feeds and speeds . . . reduced cut and try . . . greater accuracy . . . faster positioning . . . far less non-productive machine time and increased machine utilization.

Increased machine versatility permits greater freedom in design and more frequent product improvement. Lead time often can be cut from weeks to hours. Scheduling, work routing, and time study are improved and simplified.

Workpiece handling and setup time almost always decrease with numerical control. Fewer machines and checking operations are required, freeing floor space and personnel for more productive work. Jigs often can be eliminated, and fixturing simplified.

With Sundstrand NC machines, the control of all phases of production affecting final cost is placed in the hands of management and engineering.

In your shop, the opportunities for such savings can be determined through a Sundstrand "Engineered Production" analysis, which takes into consideration such factors as initial investment, present and future work requirements, workhandling, floor-to-floor time, tooling requirements, and many others.

Write for Bulletin No. 632 describing the Sundstrand line of numerically controlled machine tools, typical applications and savings, and tooling designed for the machines.



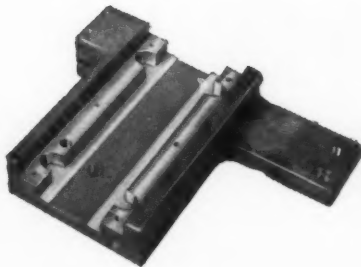
October, 1961

For more data circle No. 877 on Readers' Service Card.

MACHINES DESIGNED TO MEET YOUR NEEDS

ROCKFORD, ILLINOIS, U.S.A.

parts like these?



Aluminum indicator carriage — 9.5 minutes
Mill 4 steps and 4 pockets; drill 12 holes; tap 8; saw slot. One setup.



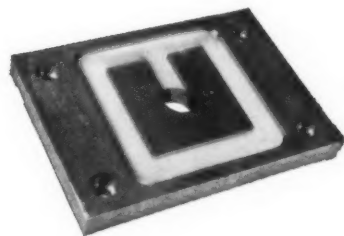
Cast iron switch box — 36 minutes
Drill 27 holes; tap 13; counterbore 4; ream 8; mill four surfaces and three pads. Three setups.



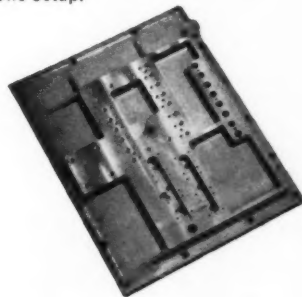
Steel support plate — 30 minutes
Drill 13 holes; tap 5; counterbore 6; mill step and pocket. Three setups.



Aluminum end spreader bracket — 12 minutes
Mill ends; mill 2 pads; ruff and finish keyway; drill and tap 8 holes. One setup.



Steel test block — 3 minutes
Mill 1" wide channel .187" deep at 15 inches per minute feed. One setup.



3-1/2 hours — 19 tools perform over 260 drilling, chamfering, counterboring, tapping, reaming and slot milling operations in top and bottom of this part. Previous method — 17-1/2 hours.

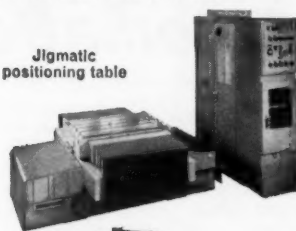


SUNDSTRAND MACHINE TOOL

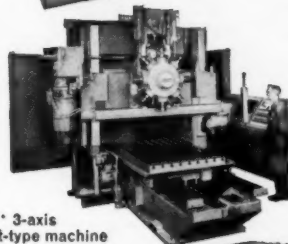
BELVIDERE, ILLINOIS • Division of Sundstrand Corporation

Sundstrand Numerically Controlled Machines . . .

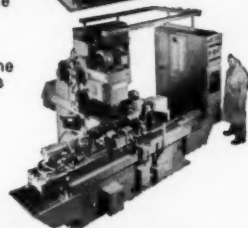
Jigmatic positioning table



* 3-axis turret-type machine



Crankshaft milling machine . . . and others

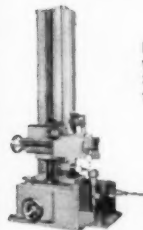


5-axis Omnimil



. . . and matching tooling for every requirement

Key-driven quick-change tools and toolholders for any Sundstrand NC machine or tool changer.



Tool-setting gage

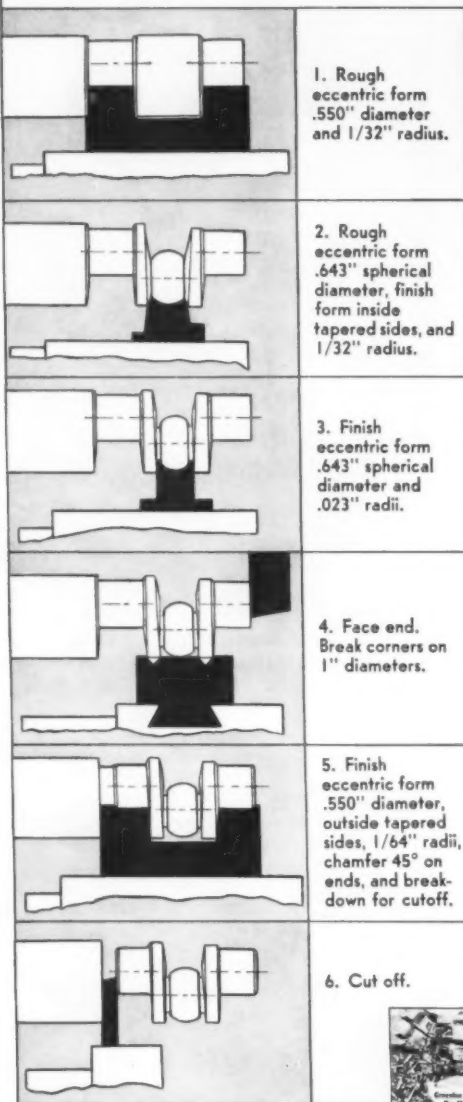


Universal setup fixture



Eccentric Forming on Greenlee Automatic Bar Machines

MACHINE . . . 1-5/8" — 6 Automatic Bar Machine
TOOLING . . . High Speed Steel
MATERIAL . . . B1112
STOCK SIZE . . . 1" round
TOOL SLIDE STROKE . . . 1-3/16" at .0042" feed
SPINDLE SPEED . . . 420 rpm 110 sfm
MACHINE TIME . . . 43 seconds
ESTIMATED GROSS PRODUCTION . . . 83 per hour



Write for your copy of Catalog A-405

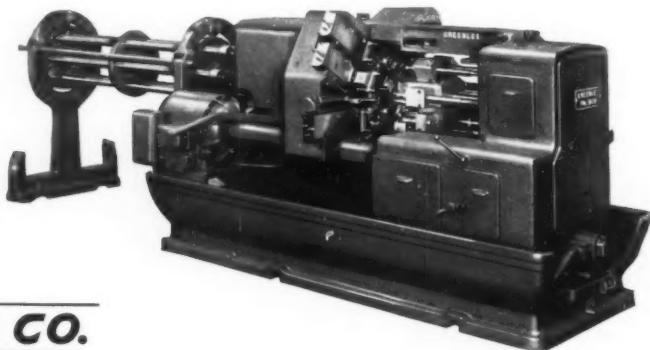


PRODUCED WITHOUT COSTLY "SECOND OPERATION"

"Union Special" relies on GREENLEE versatility to cut production costs of multiple eccentric crankshaft

Standard Greenlee Automatic Bar Machines are extremely versatile. Union Special Machine Company, manufacturers of industrial sewing machines, utilizes this production versatility to machine the multiple eccentric crankshaft illustrated. The part is machined from 1" round B1112 stock and is held in standard concentric collets. Part is machined in 43 seconds giving a gross production output of 83 pieces an hour. Sequence of operations is shown at left.

Special eccentric forming attachments mounted in the first, second, third, and fifth forming slide positions, rough and finish form the two eccentric diameters. Greenlee Bar Automatics permit greater job versatility and assure added profits. See your Greenlee representative or send us a print of your problem-part.



PRODUCTION MACHINERY
GREENLEE BROS. & CO.

Since 1863



1991 Mason Avenue ROCKFORD, ILL.

TRANSFER MACHINES • SPECIAL MACHINES • AUTOMATIC BAR MACHINES • WOODWORKING MACHINES AND TOOLS
DIE CASTING MACHINES • TRIM PRESSES • HYDRAULIC AND HAND TOOLS • COMMERCIAL CASTINGS



October, 1961

For more data circle No. 878 on Readers' Service Card.

MACHINES DESIGNED TO MEET YOUR NEEDS

ROCKFORD, ILLINOIS, U.S.A.

QUICK-TILT

surface grinding selector-switch-actuated
power spindle tilting

Most Significant Advance in 30 years-**BASIC** to your cost, materials, and quality control problems in **FLAT** **MACHINING** !!!!!

Are you responsible for evaluating new production methods and reducing costs? If you are, here are some facts worth considering.

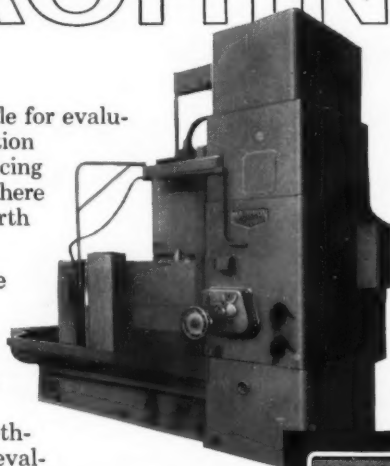
Cost studies prove that QUICK-TILT surface grinding is a *new method*—not just a machine feature. It is a method which must be evaluated with conventional "big chip" machining. As such, it offers economies inherent only in grinding.

Power spindle tilting takes surface grinding out of the narrow category of a finishing process. This and other features have made it a basic development which can increase your ability to:

1. Reduce hidden costs
2. Machine difficult materials
3. Increase return on capital
4. Improve product values

Performance of our new grinders surpasses all previous standards by a considerable margin. That's why people are talking about "abrasive machining." What technical advances have created this difference? Primarily—three:

1. Grinding wheels have been improved. Tougher bonds retain the abrasive longer under heavier cutting pressures.
2. More horsepower and rigidity have been added to the machines. We use up to 200 hp on some vertical-spindle rotaries.
3. New power spindle tilting combines the advantages of roughing and finishing.



On the average, production can be increased 50%, or more, over conventional grinding. Using the leading edge of a tilted wheel, you can quickly machine parts to within a few thousandths of final size. Extra horsepower permits you to use higher downfeeds. This increases grain penetration and rate of metal removal.

Location of the low point on the wheel (tilted) has no effect on final flatness. With a flip of the switch, you can return the spindle to its true perpendicular position automatically. Then, a fast finish-grind gives you a perfect cross-hatched finish on every piece. In effect, you get two operations for less than the cost of one.

Self-dressing wheels are used to reduce downtime. You get the maximum number of productive min-

utes per hour of machine time. Considering all elements of total cost (not just time per piece) this is the ultimate in economy. Yet you get all of the precision and fine finish of surface grinding.

How much can you save? Costs vary widely, but here are some examples: Meehanite tables, formerly planed, are being ground at a saving of \$14.93 each. Total machining cost, including machine-hour charges, labor, wheel replacement, setup, and loading time, was reduced from \$19.87 to \$4.94 per piece. On a cast iron bracket, formerly milled, surface grinding is saving \$9.83 per piece.

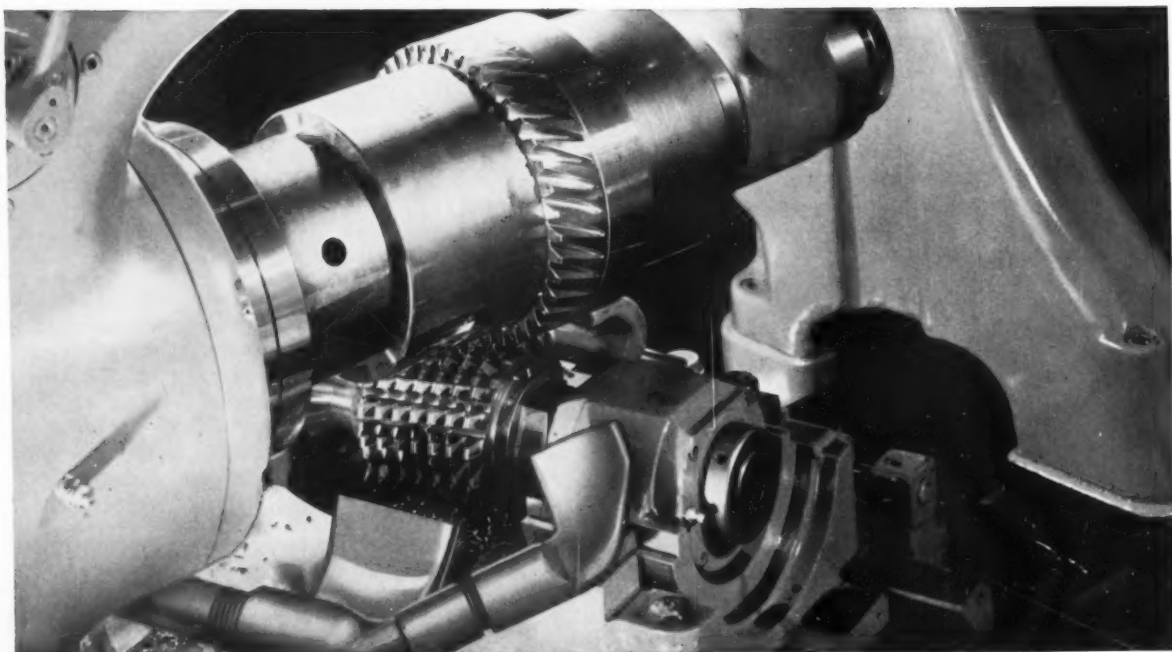
If you are interested in *abrasive machining*, send your pieceparts for a sample grind and cost estimate. Your Mattison dealer will make the arrangements.

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Rockford, Illinois • Phone WO 2-5521



NEW WAYS TO SPEED PRODUCTION OF HIGH-QUALITY COARSE-PITCH GEARS This Barber-Colman No. 14-15 hobbing machine is FAST. It produces two 6 D.P., 41-tooth helical gears (1-1/2 face) in 3 minutes, 50 seconds. Finish and lead accuracy are excellent. It takes a machine with plenty of capacity, rigidity, and precision to combine this kind of accuracy with high production. Here's how. Bayonet-lock hydraulic tooling, antifriction spindle bearings, and optional DUAL-FEED all slash important seconds from the cutting cycle. Speed of the 5-in. dia hobs, which have three starts and 20 flutes, is 313 rpm. Although index speed is high, generating

PRODU

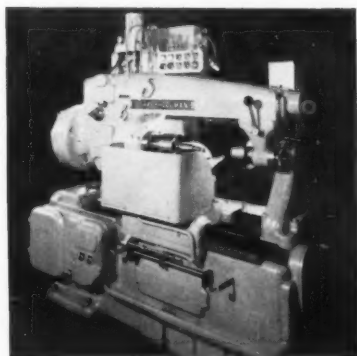


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MACHINES DESIGNED TO MEET YOUR NEEDS **ROCKFORD, ILLINOIS, U.S.A.**

flats are minimized by the number of teeth cutting. "Roughing" feed of .080 ipr shortens the approach cycle. When the hob reaches full depth, feed drops automatically to .045 ipr for finishing. Thus, excellent finish is pro-



duced at MAXIMUM SPEED. Performance like this is what makes the Barber-Colman No. 14-15 America's leading coarse-pitch hobber. Its superiority can be measured in economy, versatility, capacity, and accuracy... as well as in convenience,

CTIVITY

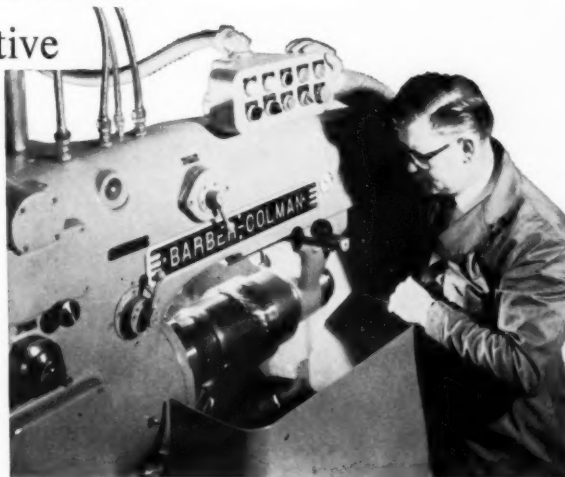
service, quality, and productivity. And this Dual-Feed model is just one of several important new concepts you can see demonstrated in a visit to our TEST CENTER.

Your Barber-Colman representative will make all the arrangements.

BARBER-COLMAN COMPANY



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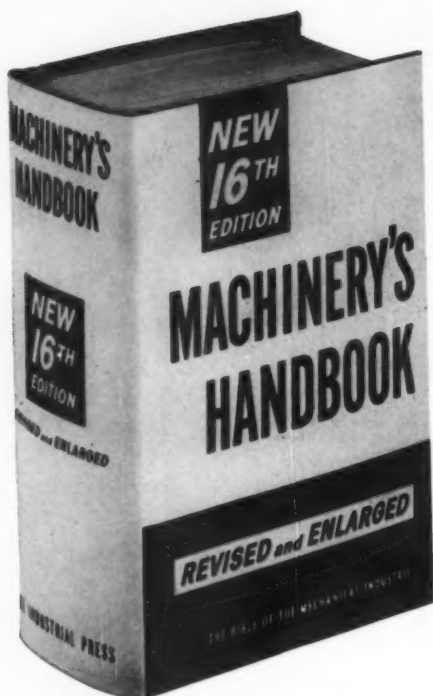


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FOR PRODUCTION MACHINE TOOLS IT'S **ROCKFORD, ILLINOIS, U.S.A.**





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saving time, work and money for its users. No wonder over a million and a quarter copies have been sold! No wonder it has earned the reputation as "the bible of the mechanical industries"!

And now, in this greatly revised and enlarged edition, you get all the latest and best principles, practices, specifications, standards and other useful working data. The 16th Edition reflects the tremendous advances the metalworking industries have made; and it gives you the information you need to keep pace with that progress. The comprehensive cross-index and the convenient thumb-index will help you find any one of the subjects in seconds!

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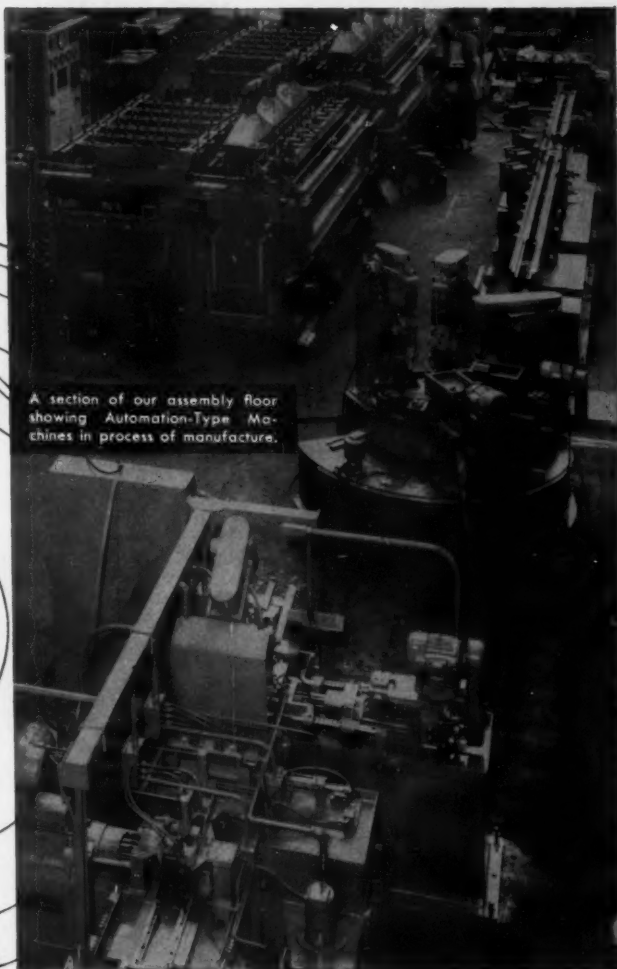
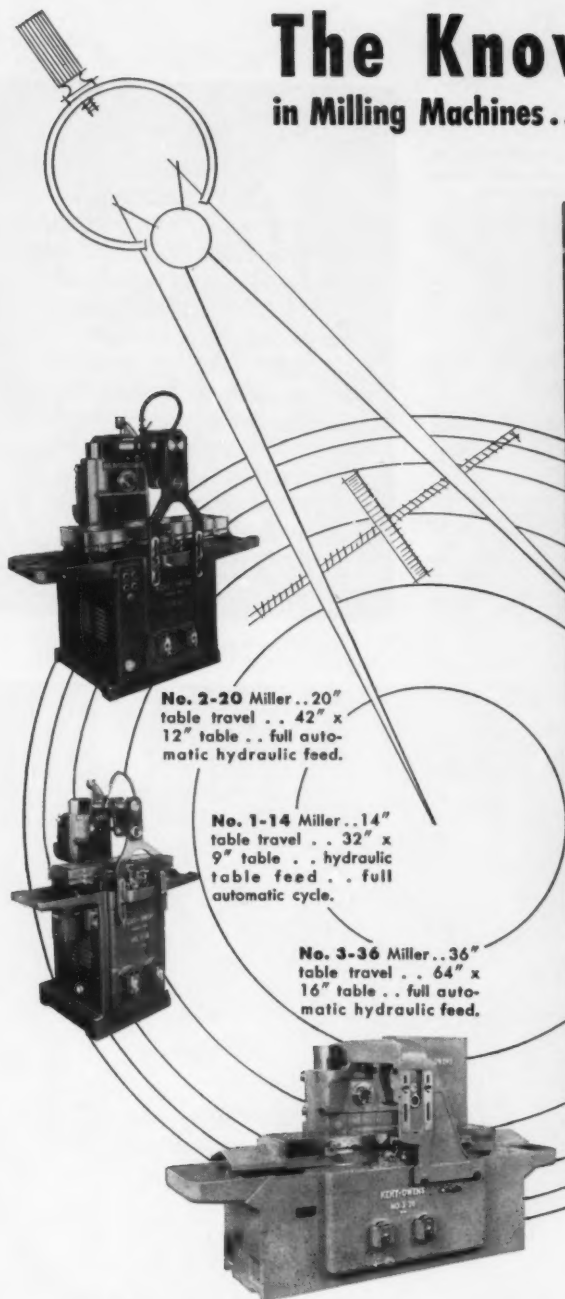
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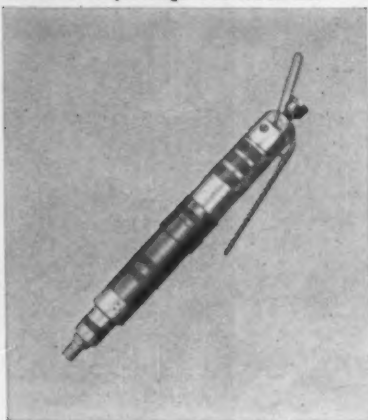
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"One-Shot" Air Screwdrivers with offset or lever handles; reversible or non-reversible; silent exhausts. Torque range: 7 to 100 in.-lbs.



* The secret of CP "One-Shot" Fastener Driving Tools lies in the precise torque sensing ability of the tools themselves. Put the tool on the work—press the throttle—the instant precise torque is attained *all* driving action stops. Its torque-awareness is unequalled by any clutch for accuracy and consistency. So don't just specify "torque control"... be sure you specify CP "One-Shot."



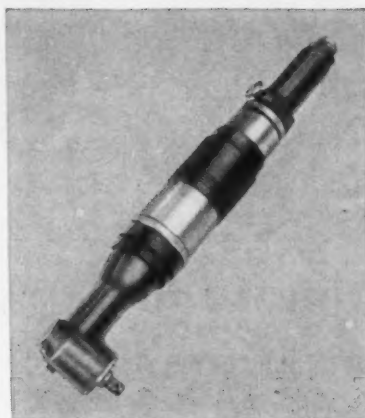
CP "One-Shot" Screwdrivers can save up to 75% in fastener driving time...eliminate stripped threads.



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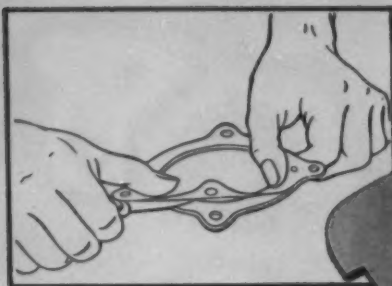
Since the first CP "One-Shot" torque control power screwdriver was introduced in 1954, industry has come to realize the *real plus values* of the consistent accuracy these tools maintain. They have proved their money-saving advantages because:

1. They cut spoilage and rejects to a minimum.
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CP manufactures the most extensive line of "one-shot" tools available today. Let a CP Torque Control Specialist help you solve your fastener driving problems. *Chicago Pneumatic Tool Company, 8 East 44th Street, New York 17, N. Y.*



"One-Shot" Nutrunners hold their settings...simplify training of operators.



**Never underestimate the
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We address this statement to design, tool, production, inspection and assembly engineers...

Holding to extremely close tolerances is a costly procedure. You know that. What you may not know is that frequently you can ease up on tolerances without sacrificing a single thousandth of your precise assembly objectives.

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Keeping up

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Loring F. Overman

- ★ **Policy Shift Uncovers a Need**
- ★ **Machine Tools High on List**
- ★ **Commerce Chief Urges Modernization**
- ★ **Investment Tax Credit Status????**

RECENT Congressional approval of a \$46,700,000,000 defense appropriation for the fiscal year ending June 30, 1962, calls a new set of signals for the machine tool industry. Of particular interest to those who design and build industrial machines is "a transformation of national defense policy from primary reliance on atomic weapons to emphasis on flexibility designed to meet any type of limited or all-out war."

The quoted reference is from a bulletin of the Machinery and Allied Products Institute which informs its members of the shift, and of the \$16,200,000,000 provided for procurement of military end items, equipment, components, and research and development. The overall budget, MAPI notes, involves the largest percentage defense appropriation in history. The largest percentage increase over 1961 will be for ordnance, vehicles, and related equipment—reflecting the announced build-up of ground forces.

Policy Shift Uncovers a Need

"A significant effect of the flexible defense program," MAPI points out, "is that it places renewed reliance on a modern and dynamic industrial plant. The push-button war philosophy implied primary dependence upon military power *in being*, with little regard for future productive capabilities. The new defense program, therefore, may have significant implications with respect to the attitude of the Federal Government toward the need for a modern industrial plant and proper incentives to achieve it. It may also affect the further development and administration of policies in such areas as government-owned productive equipment, facilities contracts, defense planning, etc."

In considering the impact of the \$16,200,000,000 to be spent by June 30, 1962, it should be noted that the total represents an increase of \$1,300,000,000 over the March estimate. The increase and the change in direction apparently will result in new business for a number of metalworking product lines. Digesting official legislative reports and hearings, MAPI lists some of the product lines likely to share in new orders.

Machine Tools High on List

Machine tools—in addition to funding for the planned machine tool modernization program . . . the major

increase in procurement of production line ordnance items should result in some new machine tool orders not previously anticipated.

Materials-handling equipment manufacturers should receive substantial orders from munitions contractors.

Trucks and motor vehicles—specific provision is made for 70,000 combat, support, and general-purpose vehicles.

Textile machinery—to be in increased demand to supply uniforms, tents, and other cloth items.

Ground support equipment for increased bomber wings . . . a variety of equipment affecting a wide range of suppliers of capital goods and allied equipment.

Construction equipment specified includes bulldozers, cranes, and allied engineering equipment.

Components and spare parts—"The net increase in procurement expenditures," MAPI comments, "should have a resultant impact on the defense orders of component manufacturers of such items as hydraulic equipment, motors, gears, pumps, bearings, valves, etc. There should be new spare parts business from at least two programs—continuance in service of B-47 wings previously scheduled to be deactivated, and the activation and conversion of a number of Naval vessels presently in mothball status."

Commerce Chief Urges Modernization

Commerce Secretary Luther H. Hodges has stated repeatedly that he does not share the view that production lines can be considered modern without being modernized. Speaking recently in San Francisco and elsewhere, he said: "Modernization of our productive plant and equipment is an important area in which the Commerce Department is trying to provide new leadership. By pressing our own modernization, we can keep our unit costs down while maintaining and improving our traditionally higher standards of living. To this end the department is supporting the President's program for tax credits to provide new incentives to business to increase their investments in new plant and more modern equipment."

Investment Tax Credit Status????

The fate of a tax credit to stimulate investment and modernization of productive equipment is not yet clear. The Commerce Secretary indicated certain agreement on the subject, and only a few days after the President's defense budget message, Treasury Secretary Dillon spoke favorably concerning such a credit. Writing to the chairman of the Ways and Means Committee, Secretary Dillon renewed his request for an 8 per cent investment tax credit.

On the other hand, some have noted that the President made no reference to the subject in his defense budget message. Instead he spoke hopefully of a balanced budget, and indicated he would not hesitate to raise taxes if such a step appeared advisable.

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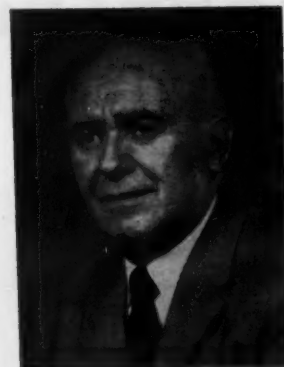
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**This Is Our New Model Designed And Manufactured To
Meet Exacting Requirements For Close Tolerances And
Fine Finish.**



Imports Cost Jobs As Well as Money

WHEN governmental bureaus and trade associations issue statistics concerning imports from foreign countries, figures are invariably given in dollars or, as in the case of metals, in tonnage. Such statistics indicate the amount of business lost to American concerns and imply reduced profits in proportion to this loss.

That imports affect the workman fully as much as business, and perhaps more, was emphasized recently to the House Subcommittee on the Impact of Imports and Exports on American Employment by the spokesman for the tool and fine-steel industry. This spokesman cited figures to indicate that imports of tool steel last year and products made from tool steel cost this country 2000 jobs. If figures could be projected to show the total reduced employment caused by imports in all affected industries, the results would be startling.

It must be remembered, of course, that foreign trade is a two-way street. We cannot expect countries to buy from us if we do not buy from them. And, as a matter of fact, we would lose much money and cause considerable unemployment in various industries if our exports were curtailed very much. In the interests of international harmony, imports and exports must be expanded. To our great advantage, the United States has always enjoyed a considerable excess of exports over imports.

There are certain industries, however, that are vital to national defense, such as the machine tool and steel making industries, that should receive special consideration. It is imperative that some measures be taken to see that their productive capacities are not too greatly reduced because of business decline due to imports. The slump in the machine tool industry over the past several years has already caused an appreciable toll on the skilled help of that industry—help that would be absolutely essential in a national emergency and which would be difficult to obtain on short notice.

The House Subcommittee on the Impact of Imports and Exports on American Employment has no easy task if it undertakes to make recommendations that will suit everybody concerned. It just cannot be done. There are not enough King Solomons!

Charles O. Herb

EDITOR

PORTABLE "SERVICE CENTER" sparks new ideas and savings



Hundreds of companies have saved money, improved products and cut production waste as the result of opportunities presented by the Ryerson "Metalogikit."

How? This unique kit is a veritable portable service center . . . lets you explore many alternatives to material you now use. For example, you can compare several different cutting methods on the same piece of steel to see which is best for your application.

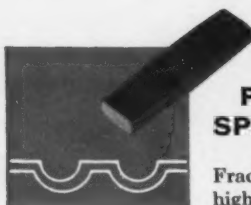
Following are a few random examples showing how Ryerson specialists, using the "Metalogikit," have helped customers with a variety of problems—many similar to those you may face every day.

If you would like to put the Ryerson "Metalogikit" to work for you, call your Ryerson representative for a demonstration—for unbiased recommendations on steel, aluminum, plastics and metalworking machinery.



KIT SPOTS SAVINGS

Scratches and grooves normal to cold drawn, seamless tubing caused high manufacturing costs for a company making small, light-wall hydraulic cylinders. The small I.D. had to be honed to eliminate these faults—often too much metal was removed for proper piston fit. A Ryerson specialist suggested a switch to *welded tubing*. Using a sample from his "Metalogikit," he pointed out the better finish that eliminates expensive honing. The switch was made with these results: higher production, low reject rate, improved product, lower purchase price per foot of tubing.



KIT SUGGESTS PROFITABLE SPEC CHANGE

Fractures and rejects were extremely high for a manufacturer cold forming two severe bends in flat, hot rolled bars. A Ryerson specialist examined the $\frac{3}{8}$ " x 2" bar stock and compared it with a sample of M-1020 flattened round bar from his "Metalogikit." He explained how controlled carbon of Ryerson M-1020 bar would produce great cost-saving advantages in this operation over hot rolled, mild steel. After specs were changed to this Ryerson-supplied bar, fractures and rejects were substantially reduced—bringing new profitability.



NEW ANGLES FOR CUTTING COSTS

In making chairs, a furniture manufacturer was using *rolled* aluminum angles in 6061-T6 alloy where strength was not an important factor. A Ryerson aluminum specialist recommended using *extruded* angles in 6063-T5. Using a sample from his "Metalogikit," he pointed out that this angle would provide all the strength needed in the application, is more easily formed and has a better finish. The change in material was made—cutting costs 15¢ per unit produced.



STAINLESS FROM KIT LEADS TO SAVINGS

This company had an emergency requirement for stainless sheets. Application had always called for Type 304, 16 ga. x 66" x 81", *polished on one side*. Their Ryerson specialist questioned the need for polishing. From his "Metalogikit," he showed them a sample of 304 with a 2B finish. The company readily agreed it was exactly the finish needed *without polishing*—saving delivery time and material cost. The Ryerson man further suggested 16 ga. x 72" x 144", using the cutoff pieces for another job—reducing scrap waste on both requirements. Order was placed and delivered in plenty of time. Over-all result: a substantial saving.

STEEL • ALUMINUM • PLASTICS • MACHINERY

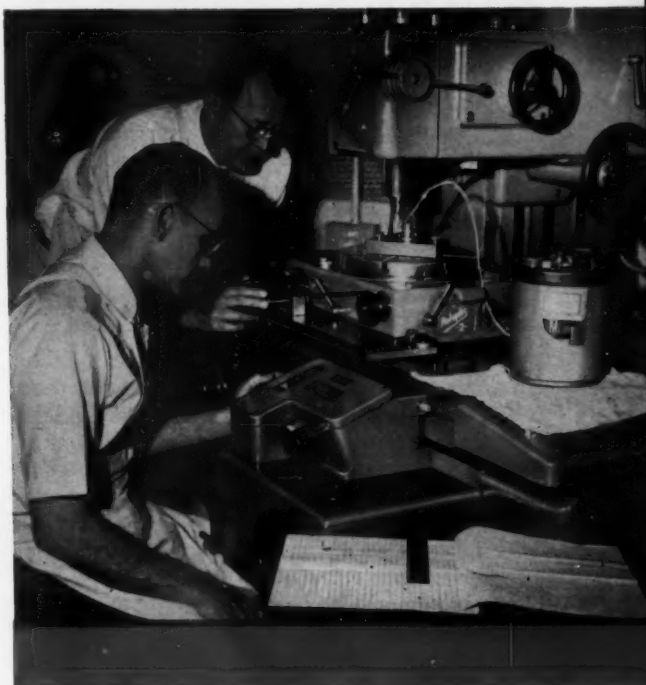
RYERSON STEEL®

Joseph T. Ryerson & Son Inc., Member of the  Steel Family

High-speed master cams generated mechanically

RAYMOND E. CHENEY, Manager
Technical Services, Development Laboratory
General Products Division
International Business Machines Corporation
Endicott, N. Y.

High cam rotational speeds (2000 rpm or more) have created a demand for a new species of small precision plate-cams. Earlier "weld-and-file" methods or other crafting techniques cannot meet the precision required in many of today's high speed applications. Now hardened master cams can be generated and finished to radial accuracies of four decimal places by a novel short-run procedure developed by IBM. Computers provide design capabilities for establishing as many control points as needed to obtain the necessary four-place accuracy in the cam master model



THE design, evaluation, and release to production of simple plate-cams, prior to the development of electronic data-processing machines, was the result of design compromises executed in metal by skilled craftsmen. The cam maker was usually a craftsman who did much of the engineering of the master cam as he went along.

However, the design engineer, who provided the cam profile data, was limited by time to the number of calculations he could make to describe the cam profile required. He found that his design success was a function of how well the cam maker or shop mechanic "engineered" the blend of the cam surface between the limited number of control points he provided. The more control points the design engineer could provide, the higher his level of confidence in the design choice. Quite frequently it became necessary to "weld and file" when measured accelerations exceeded his theoretical expectations. After a (usually soft) model cam was engineered to function within specifica-

tions, it was carefully measured and then tooled into a hardened master for reproduction, by duplication methods, of production parts.

Toolroom procedures for producing a precision master cam are as varied as they are costly and time-consuming. They are usually performed by highly skilled craftsmen with years of rule-of-thumb, trial-and-error experience behind them. Stone and measure—weld and file, or peen and file—were the methods usually employed.

Traditionally this procedure has met production cam specifications for relatively low-acceleration mechanisms utilizing spring-loaded follower systems. The design engineer could achieve accuracy in the order of three decimal places with these procedures.

However, the trend in business machines and in similar equipment is toward greater cycling speeds. Shaft speeds of 100 rpm, common ten years ago, have been boosted to speeds in excess of 2000 rpm in many applications. In most of these high-speed arrangements spring-loaded followers are inadequate. Complementary cam systems are required. But these systems, to deliver the required reliability, life, accuracy, and freedom from vibration, must be manufactured to accuracy tolerances to the fourth decimal place. Complementary cam shapes for prototype evaluation are usually generated from the active cam shape by actually constructing a 1-to-1 complementary linkage to control the machining of the blank. This immediately introduces a second-generation tolerance error and results in more time-consuming welding-and-filing, or stoning-and-measuring, manufacturing.

Today, with electronic data-processing facilities available to the design engineer, he can design and dimension the optimum cam profile for any nonuniform motion in any mechanical linkage system. Thus, the engineer can now achieve complete theoretical control of his cam design. He now has the tools to define needed data by providing as many radial control points as he deems necessary, with each point of interest on the cam profile computed to five or more decimal places. The problem of accuracy is thus shifted to the shop, where translation of the improved quantity and quality of the design data must be executed in metal.

Design data can be provided by computers in many forms, such as magnetic tape, paper tape, punched cards, printed pages, or graphs. There is considerable effort and significant progress being made by machine tool manufacturers in building precision equipment that will translate the computer information directly into finished cams on a fully automated basis. Although such sophisticated design automation is feasible and will ultimately materialize, metalworking equipment ca-

pable of high-precision hard-material machining is not yet available to the industry. Also, most prototype shops will undoubtedly find numerical- or analog-programmed cam-generating machines economically unjustified.

About 1950, electronic devices began to assume a major role in data-processing equipment. It became evident that the electromechanical devices included in data-processing systems would be the limiting components in over-all system output speeds. Improvement in cam systems designed for use in such components was given increased effort in IBM's development programs.

The IBM Development Laboratory at Endicott, N. Y., in 1950, utilizing its own data-processing machines as tools in the form of a card programmed calculator, began cam-design automation operations on computers. It soon became practical to design more efficient cam profiles and to define contours more precisely by using a greater number of control points. As more advanced data-processing equipment became available, cam-design time could be reduced and the degree of engineering analysis of high-speed, complex cam systems was greatly increased. The result of ten years' effort in this field is that factors such as acceleration, inertia, loading, deflection, displacement, pressure angles, undercutting, vibration, and their composite effects on the point of interest throughout cam-actuated linkage systems can now be incorporated in the computer's cam-design input procedure.

The simple, nonprecision, spring-loaded plate-cams of the past have been replaced, almost entirely, in data-processing machines by high-speed, complementary cams. The choice of a complementary cam-follower system is usually the result of a mathematical analysis of system dynamics, rather than the displacement accuracy of the point of interest. Cam surface-contour errors as small as fourth-decimal-place dimensions can cause intolerable acceleration shifts in the mechanism. These errors can result in excessive noise, vibration, and ultimate failure. By the same token, cam surface-contour errors and slight phase misalignment between the active and complementary cam of an assembly often cause excessive cam-follower loading, again resulting in early failure.

Most new cams being designed for IBM's data-process machines today incorporate a high degree of precision. They are computed to the fifth place and corrected, or rounded off, to the fourth decimal place. Most cams in the 2-inch diameter range are computed with at least 760 radial control points (but sometimes two or three times that many, depending upon the size and accuracy required). To obtain and hold this degree of accuracy it is necessary to produce the final cam by finish grinding after heat-treatment.



Fig. 1. Optical cam-inspection system, has the cam turned by a dividing head and all elements mounted on a special granite surface plate.

In the past, to compute and check a simple plate-cam for every $1/2$ degree of rotation in a typical system required six man-months on a desk calculator. This time was reduced to approximately eight hours by IBM's first computer applications (1950). Later, IBM's 650 data-processing system further reduced computer time to approximately twenty minutes. Today, to design a cam takes five to seven minutes on an IBM 704 computer. The latter time includes considerations of pressure angle, radius of curvature, velocity, acceleration, and other pertinent cam and linkage factors.

What do these developments mean to the foreman of a shop who must translate such data into metal? Of what value is such progress to the engineer if the heart of his mechanisms is still the result of a craft or an art? The traditional toolroom practice of scribing a cam-blank on a jig borer, then sawing and filing to the finished shape, requires weeks of skilled efforts if all available control points are actually used and checked. The practice of jig-boring a cam-blank by successive plunge cutting with a boring-bar, and finish-blending by hand, is still needlessly time-consuming. The final shape depends, as in the scribing methods, on the craftsman's ability to carefully hand-finish and check the cam surface.

In view of these developments, the Central Model Shop in the IBM Endicott, N. Y., Development Laboratory, mapped out a three-phase program to investigate and implement cam design and cutting techniques. The first phase of the pro-

gram was a thorough investigation into the various methods used by industry to accurately set up, orient, and repetitively read or inspect the actual curve of a cam and its complement surfaces. Generally speaking, engineers like to specify zero-tolerance deviation in certain areas of a cam, if feasible, because even slight deviations from an optimum cam profile can become destructive, forcing factors under dynamic conditions. Such factors directly affect the function and life of a cam and linkage system. The methods being used for inspecting cam surfaces, after study and analysis of various other approaches, were found to be the most accurate. Accurate measurements to the fourth decimal place can be readily repeated by good technicians.

The cam checkout system employs a high-quality optical dividing head, a tailstock, and an arbor-mounting assembly to hold and index the cam, Fig. 1. The dividing head is graduated to read directly to 2 seconds of arc. Cam displacement is measured by an optical measuring machine having a horizontally mounted, gravity-loaded probe carrying a precision-ground carbide ball that has the same diameter as the cam follower. Accuracy of the ball is specified to 25 micro-inches. The measuring machine is graduated to read directly to 50 micro-inches. All the measuring units are mounted on a heavy granite surface plate made to IBM specifications.

Phase 2 in the prototype cam-making process produces the first translation of the computed data into a master cam. As previously stated, there

Fig. 2. (Right) Cam-and-cutter relationship, front view, showing the honed indexing hole arrangement. Sperm oil mist is the cutting lubricant.



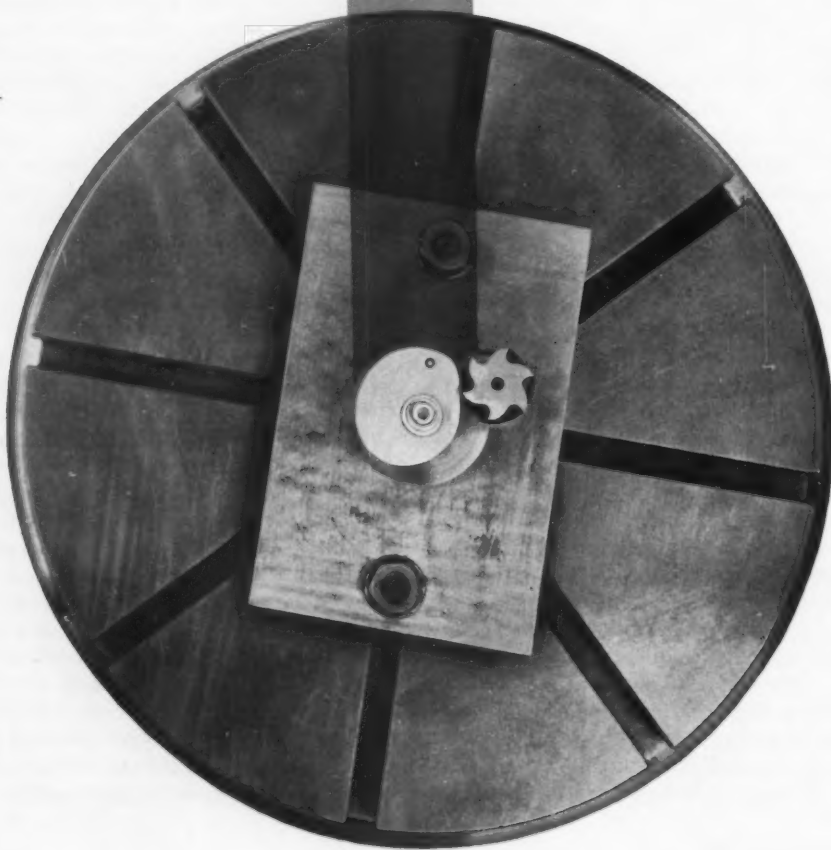
Fig. 3. (Below) Simulated plan view of the cam-to-cutter relationship. This is a "spindle-eye" view, looking down the axis of the cutter, from above.

had been no known method of accomplishing this phase with controllable techniques. Various types of machining techniques, including pantographic systems, working from oversize templates, were developed to minimize the crafting effort, but in every case the final result depended on hand correction. The company had tested and used these techniques in the past.

It must be remembered that the end purpose of a cam design is to produce high-quality cams in quantity production. It is essential, therefore, that the processing steps injected between the computational data and the final production cams be minimized to reduce degenerative and cumu-

lative errors. Ideally, and eventually, the original computed data must be used to directly control the machine that produces the final production parts.

In searching for the best answer to this phase of prototype cam fabrication, engineers carefully evaluated numerous pantographic devices. It was found that the apparent advantages of a pantograph linkage reduction system for error amplification were limited in accuracy control to the third decimal place. Repetitive performance, even at this level of accuracy, was found to be highly dependent on the ability of a skilled machine operator to set up the pantograph linkage, orient the



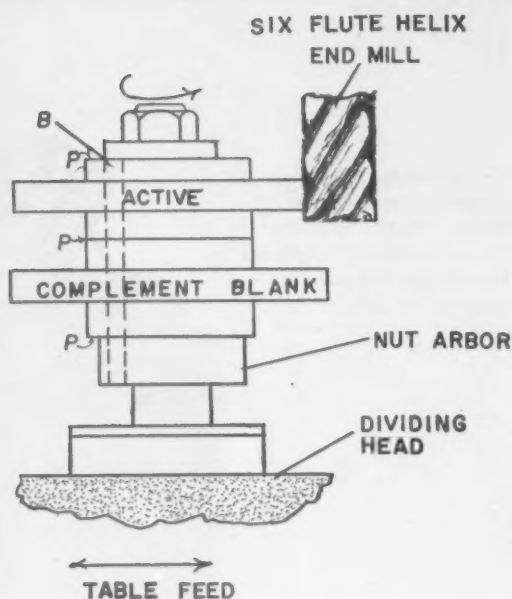
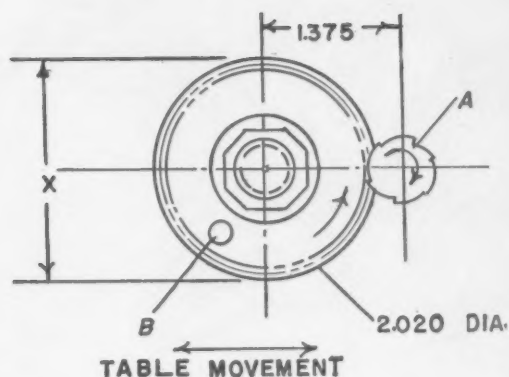


Fig. 4. Blank setup and machine orientation procedure involves taking a preliminary cut (broken line) on the actual blank in order to establish the precise cutting size of the end mill. Diameter (X) should measure 2.0000 inches after the trial cut. If it does not, the zero radial reference dial should be corrected by one-half the difference between 2.0000 and the actual measurement of diameter (X). In the sketches, A is the expected 0.750-inch cutting diameter, B is the working pin, and P signifies surfaces that are ground and parallel.

work, and "feel" the cutting operation. Furthermore, making the enlarged master template still remained a hand-blending operation. It was concluded that 1-to-1 translation of the data, under control of the most accurate equipment available, would insure the best results. This decision sent the cam problem back to the jig borer or jig grinder in combination with an indexing unit or dividing head having inspection level accuracy.

After careful experimentation and process refinement, the following procedure was adopted as a standard method for cutting the original active and complementary master cams:

Special shop-design cam-blanks are machined on a conventional lathe. For complementary systems, two similar blanks are prepared for eventual mounting as a pair, to be successively contoured in a single setup. The blanks usually have a face width of approximately 1/8 to 3/16 inches. A high-grade AISI 4150 steel, toughened to Rockwell C 28 to 33, was found to produce the best end result. Preparation of the mounting and timing index holes in the blanks is directly reflected in the final accuracy of the master cam. Therefore, the use of honing techniques to prepare the mounting is absolutely essential to obtaining maximum precision and control of the process.

Both the active and complementary blanks are mounted together on a precision nut arbor carried vertically in an indexing device capable of accuracy within 2 seconds of arc. The indexing device is mounted in an optical jig borer, with its

nut arbor zeroed in with the jig-borer spindle prior to mounting the cam master blanks, Fig. 2. Optical equipment is recommended for this operation because the table direction can be reversed without backlash compensation, and can also be incrementally set rapidly.

A multiple-fluted (six-flute preferred), side-cutting stub end mill, concentrically ground to the cam-follower size diameter and carefully mounted in the jig-borer spindle, is used to machine the cam master, Fig. 3. The heavier the cutter and the shorter the tool flutes, the more accurate it will cut. If the cam-follower size is less than 1/2 inch in diameter, it is advisable to have the cam calculated to be cut with a larger-diameter cutter. In such cases, two sets of figures (radial and index) can be provided by the computer. One group of figures is used to cut the cam with an oversize cutter; the other set is used to inspect the completed cam with a regular follower-size probe.

In operation, and in reference to a complementary cam pair (this also applies in part to a single cam master), the table is moved clear of the cutter and the spindle lowered past the face of the top blank and to a point just above the face of the lower blank, as in Fig. 2. The blanks to be cut must be at least 0.040 inch in diameter greater than the finished diameter of the cam at its highest point.

With the tool turning at approximately 300 rpm (for a 3/4-inch diameter cutter), the work is advanced into the side of the cutter to a depth of

Fig. 5. Master cam is ground to an accuracy of four decimal places, with the cut continuously monitored by the electric comparator gage on the left.



about 0.010 inch. Sperm oil is the lubricant, delivered in a vapor spray to the point of cutting. To determine the actual cutting size of the spiral mill, a complete revolution of the blank is cut by slowly and steadily hand-feeding the index-table. This trial cut is made at the beginning of each set-up to insure actual cutter orientation. Measuring the blank diameter thus cut, and relating it to the zero setting on the jig-borer table, indicates any required correction of the radial zero reference.

The top cam-blank can now be cut. It should be roughed about 0.010 inch oversize and then finished to final size by an additional rotation of the indexing table, Fig. 4. The roughing cut may require some rough milling, depending on the

final cam shape. Plunge cutting will remove large areas of the blank stock if desired. The final roughing cut should start at the index position of the greatest radial distance. With the cutter turning and lowered to its original setup position, the jig-borer table should advance the blank into the cutter 0.010 inch less than the finish position for that index point. This will leave 0.010 inch of material at this point to be removed by the finishing cut. With the computer data properly arranged to match the rotation of the indexing table, the blank should be rotated to the next full-degree index position and stopped. The jig-borer table is then advanced into the cutter to the radial dimension for that index position with the 0.010 plus material factor included. Then, with the jig-borer table resting at this position, the dividing head is indexed to the next full-degree position and rested. Again the jig-borer table is advanced into the cutter to radial distance for the index position with a 0.010 plus material factor withheld. This process is repeated for each full degree of descending radial values. At any point on the cam where the radial values do not change (as in the case of a dwell) rotation of the index-table continues until a change in radius is required.

At any position where the next radial distance is increased, or at the start of a "rise" in the cam curve, it is essential that the sequence of tool and work feed be reversed. For example, if at the end of a dwell the next radial distance is greater, the dwell-distance feeding of the indexing table

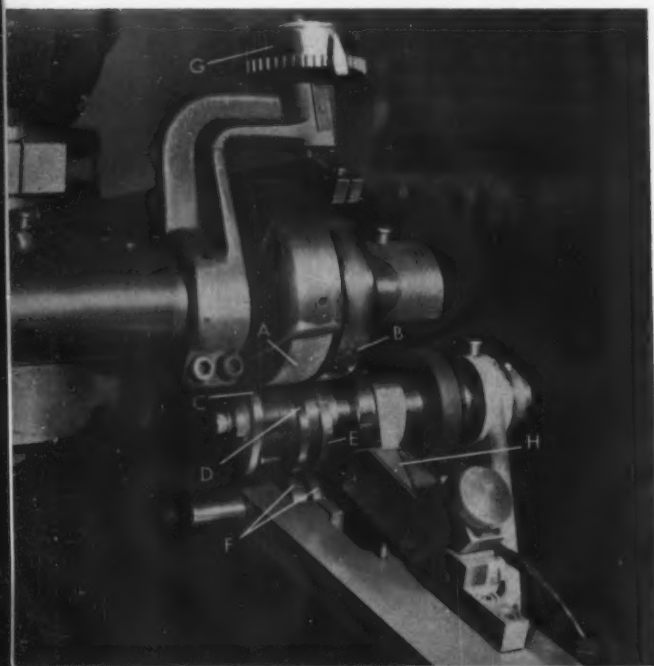


Fig. 6. Close-up of the high-precision cam-grinding arrangement showing the electronic comparator probe operating from the reeds touching the tracking rollers.

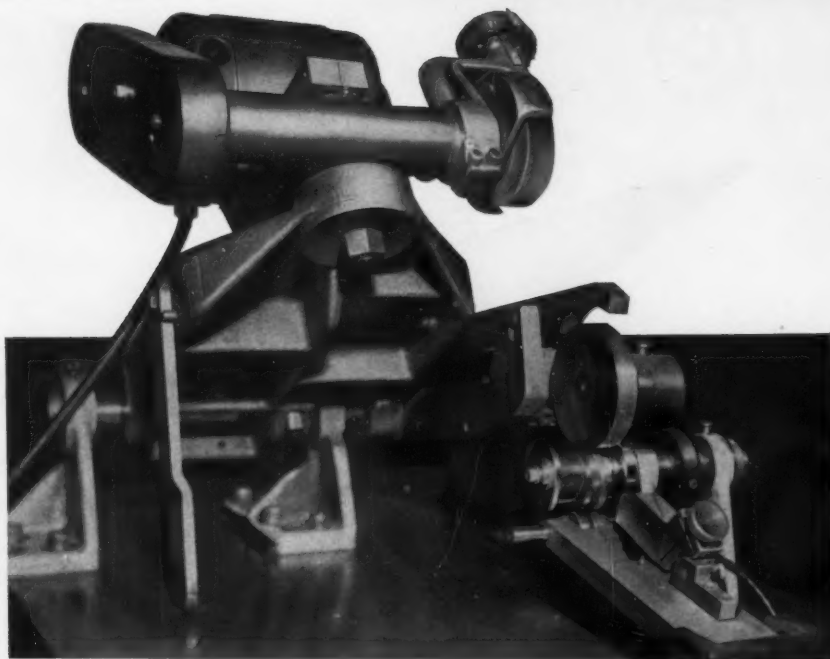


Fig. 7. Grinding head lifts off the cam follower for maintenance or loading purposes.

should be stopped at the last index point in the dwell. The jig-borer table is withdrawn from the cutter a distance sufficient to meet the next radial point. Then the blank is index-advanced to that point. This, of course, requires a machine that does not have to compensate for table lead-screw backlash. This process is continued around the cam until the entire roughing cut is finished.

The finish-size contour is accomplished in the same manner, using all of the index positions supplied, while exercising even greater care to insure smooth feed and precise setting of the jig-borer table and the index-table. Actual results have proved it is more accurate and more economical to make this sequence a two-man operation. One

man indexes the blank while the other man advances the table and reads the script aloud (heading illustration).

After machining of the top blank has been completed, the timing index hole is carefully drilled and jig-bored through both blanks and into a shoulder of the nut arbor. The top blank can then be removed. The lower cam-blank is dowel-pinned into the arbor to prevent angular slippage during both the removal of the top cam and subsequent rough machining. Now the lower cam-blank can be cut in the same manner as the top cam, starting from the same zero orientation.

Prototype cams generated in this manner can be
(Continued on page 148)

Fig. 8. Side view of the cam grinder in operating alignment showing the two drives and control adjustment. The large knurled knob at the rear is the vernier for fine grinding.





LITTLEJOHN MISSILES

MADE IN LARGE NUMBERS

SOME of the latest metalworking techniques are now used to turn out Littlejohn rocket motors on a mass-production basis. This rocket, which is designed to follow a ballistic trajectory, is being manufactured under prime contract with the Ordnance Corps by the Consolidated Western Steel Division of United States Steel Corporation, Los Angeles, Calif. It is of the solid-fuel propulsion type, and is unique in that it is rotated on its launching rail prior to firing. The rotation, which continues while the rocket is in flight, imparts a high degree of accuracy to the missile, making it an effective weapon in support of troops in the field as a supplement for heavy artillery. Machined parts that will be assembled to form a rocket engine are seen in Fig. 1.

The rocket motor was designed and the prototype developed by engineers at the company's Los Angeles facilities expressly for production by the shear-forming (or spinning) technique. In construction, the principal component of the motor is the shell (or case), which begins as a rough forging weighing approximately 250 pounds. It is

forged of a special steel developed by United States Steel expressly for the program. Production lots of these forgings, after careful individual inspection, are sent to the six-spindle vertical chucking machine illustrated in Fig. 3. Two separate runs through this machine are required to prepare the forging blanks for the subsequent sheer-forming operation.

In the first setup, one end of the blank is machined at each of five work stations. After completing this cycle, the machine is retooled for the second series of operations, which similarly is performed at five work stations. All cutting tools used are of the tungsten-carbide throw-away insert type, allowing a high rate of metal removal from the blanks. Wall thicknesses of the cylindrical blank must be held to the very close tolerances necessary to provide the control required for the next operation. This machining reduces the forging from its original 250-pound weight to a final weight of 90 pounds.

The blanks are then moved to the spinning machine (Fig. 4), where tool rings, exerting 120,000



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pounds of force, shear-form them against a polished, hardened-steel rotating mandrel. This forming reduces the wall thickness of the blank, and increases its length along the mandrel. Hardened, precision-ground templates guide the paths of the tool rings, thus determining the extent of the reduction in material thickness and providing close control of the spinning operation.

The shear-forming technique is particularly suited to this application, since the resulting increase in yield strength of the material due to the cold-working is sufficient to eliminate any need for heat-treating the missile case. Spinning is performed three times on the forging blank, reducing the wall thickness in equal increments from a nominal 1/2 inch to 0.100 inch.

The length of the case after spinning is essentially two and one-half times that of the machined blanks. The smooth finish obtained on internal and external surfaces by shear forming satisfies the high standards required under the engineering specifications for the missile cases. For example, the interior surfaces resulting from the op-

eration have approximately a 32-micro-inch finish.

Not only does the use of spinning preclude the possibility of distortion which would result from heat-treatment, but it also eliminates any need for a longitudinal seam and the attendant distortion from welding. The process also serves as a material-quality inspector in that any flaws, laminations, or inclusions which might be in the forging are immediately uncovered. Such imperfections present themselves readily to visual inspection after shear forming, each rocket case being inspected prior to subsequent operations.

More nearly resembling motor cases than forging blanks, the parts are at this point transferred to a lathe (Fig. 5) adapted for production of the Littlejohn case. This machine, with its special attachments, automatically centralizes the missile case, chucks it, contour-turns the forward end to a partial hemisphere, and trims the aft end to the prescribed length. The contouring is required on internal and external surfaces of the forward end.

From the automatic lathe, the motor cases are moved to a special setup (Fig. 6) designed and

Shear forming and automatic machining are helping to provide large quantities of these

built by Consolidated Western Steel for welding the case to a formed steel head by the submerged-arc process. Immediately following this joining, a skirt ring (for fairing purposes) and a pedestal section are also welded to the case by the same process. Each weld is X-rayed 100 per cent to assure maximum quality and reliability of the rocket case, and a permanent record is maintained of the X-rays of each case by serial number. Although the surplus weld deposit inherent in the submerged-arc process is held to an absolute minimum, any excess deposit is removed by grinding prior to X-ray examination. This grinding further serves to assure the balance and concentricity of the motor case required for stability of the rocket in flight.

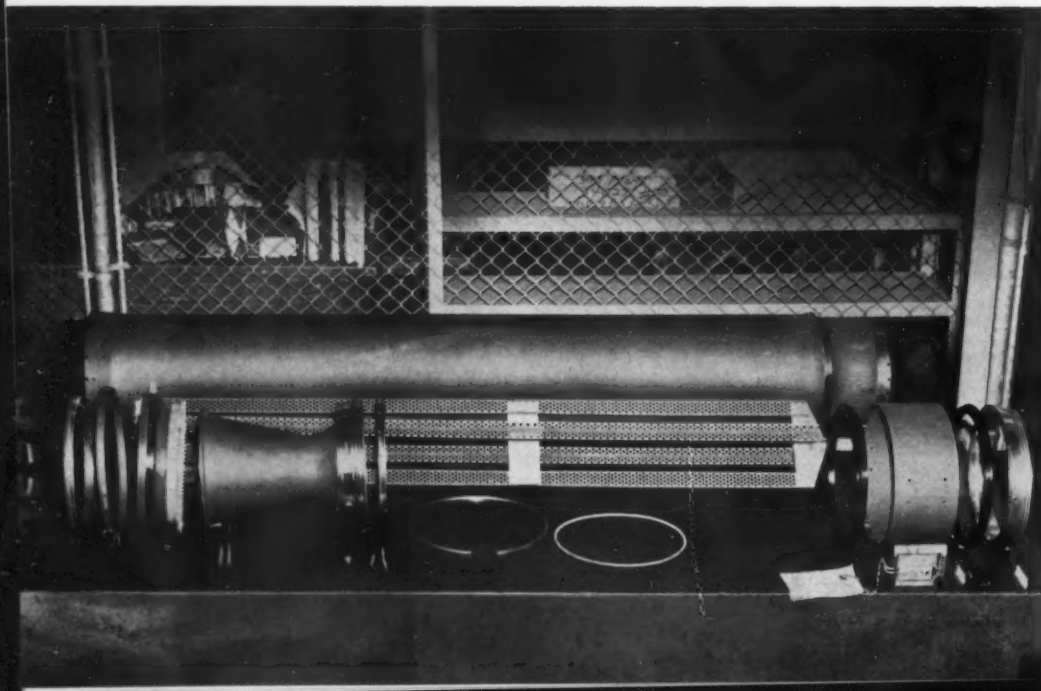
The missile cases are then transferred to the special automatic lathe illustrated in Fig. 2, where they are machined in two series of operations, each sequenced through the use of limit switches

and relays. In the initial series, the machine grips the part on an expanding mandrel, finish-machines the aft end to length, and turns the aft end to a precise contour that blends into the motor-case wall. The lathe then bores the forward end of the case at the pedestal section, after which two antifriction bearing seats external of the pedestal section are semifinished.

In the last series of operations, the machine first bores the aft end of the rocket case and provides a precision groove for a retaining ring that is subsequently used to secure the finished nozzle in position. When this is accomplished, the lathe automatically finish-machines the two antifriction bearing surfaces and faces the pedestal section to length. Then it bores, turns, and faces a boss in the formed steel head.

After a thorough inspection, the parts are sent to a special automatic drilling, tapping, and milling machine (Fig. 7). The motor case is one of

Fig. 1. Finished-machined components that are assembled into a rocket engine for the missile.



effective weapons for field troop support. The motor cases begin as forgings of a special steel

three major components to be processed in this equipment. Principally, the machine is pneumatically and electrically controlled, the design being such that only fifteen minutes are required to change the pneumatic and electrical systems for the production of one part to those for another. All drilling and tapping accomplished in the equipment are of high quality, with good tool-service life currently being attained. Thirty-nine holes are drilled, countersunk, and/or tapped in the motor case, all in automatic sequence. In addition, a small milling head, incorporated in the machine, performs a slotting operation at the forward end of the case.

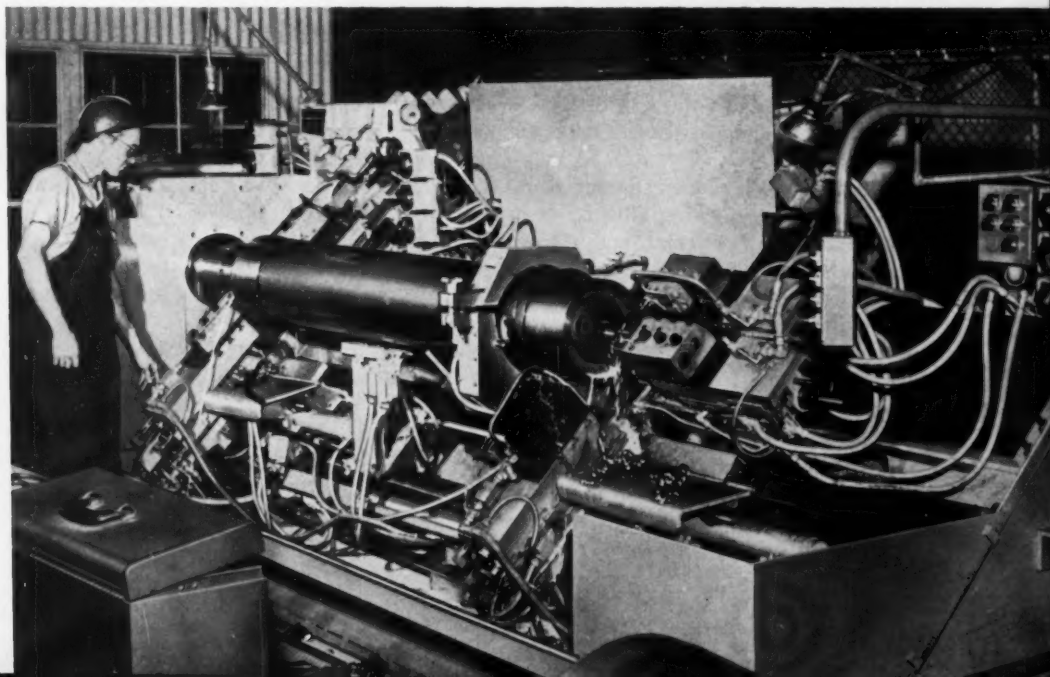
A second principal component of the Littlejohn rocket is the nozzle, which begins as a rough closed-die forging weighing approximately 110 pounds. In five operations the forging is automatically machined, the cycles again being sequenced by limit switches and relays. The nozzle, forged

of Type AISI 4130 steel, is finish-machined to a weight of 34 pounds.

In part, the operations consist of machining the profile of the periphery and the inner surface, boring (Fig. 8), turning, grooving, facing, and form cutting, all to close tolerances. The time cycles for the finishing of each part are short and the finishes produced are smooth. Tungsten-carbide insert tooling is employed. After rigid inspection, the nozzle is transferred to the special drilling and tapping machine, where twenty-four holes are produced in the flanged end. These holes are used for mounting another major component, the nozzle extension.

The nozzle extension is also a closed-die forging, but is made of Type AISI 1018 steel. It is automatically machined in four operations which rough-turn, rough-bore, groove, profile, finish-bore, and finish-turn the part, as well as face and groove each end. After this machining, the noz-

Fig. 2. Two series of operations are automatically performed on the missile cases in this lathe.



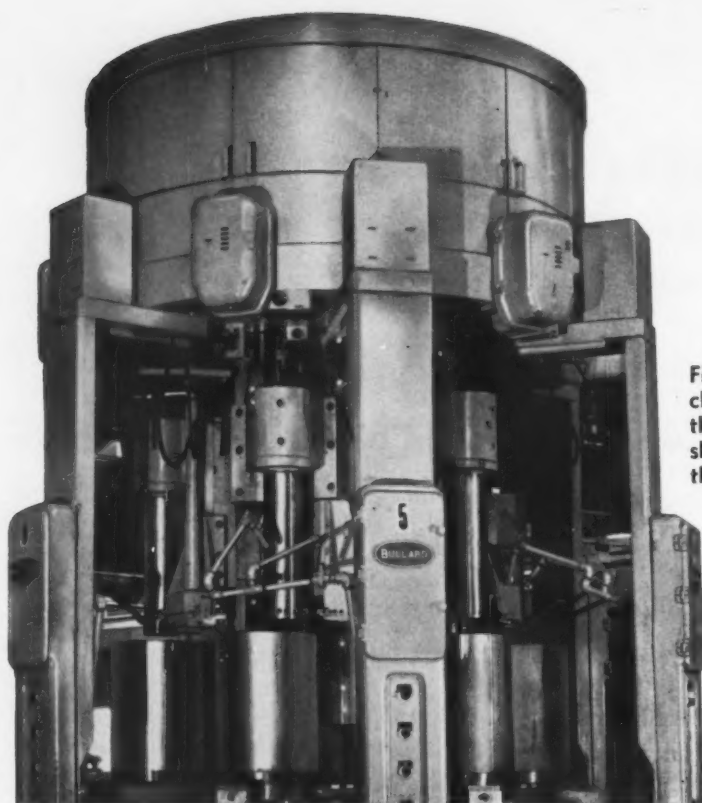


Fig. 3. This six-spindle vertical chucking machine automatically prepares the motor-case forging blanks for shear forming. Two separate runs through the machine are required.

zle extensions are also drilled, tapped, and milled in the special machine seen in Fig. 7. In a single setup, thirty-four holes are drilled and tapped in sequence, the machine indexing automatically after each hole is completed.

A simple but most difficult part to machine is the front shoe barrel, which mounts the forward shoe to the case for accurate alignment and guidance of the rocket during launching. Turning and boring tolerances, and those on concentricity and ovality, are such as to allow insertion of precision antifriction bearings in the front shoe barrel for rocket rotation.

Requiring neither strength nor durability, an aluminum captive locking ring is located at the forward end of the pedestal section to receive the rocket warhead. These captive locking rings are machined on conventional turret lathes.

Since durability is also not a specific requirement for the forward shoe, this part is machined to close tolerance from an aluminum extrusion. The shoe, which is released from the rocket immediately after firing as it leaves the launching rail, has an intricate built-in mechanism to assure this release. Each forward shoe is rigidly checked in a functional test before assembly to the shoe barrel. Painting of the rocket components is ac-

complished while on an overhead conveyor which carries them through a priming paint booth, a drying oven, a finished-coat paint booth, and a second drying oven.

At assembly, the nozzle is mounted on the case, after which two antifriction bearings are attached to either end. The front shoe barrel is mounted on one set of bearings, while the other set provides for a future mounting of an aft shoe and barrel assembly.

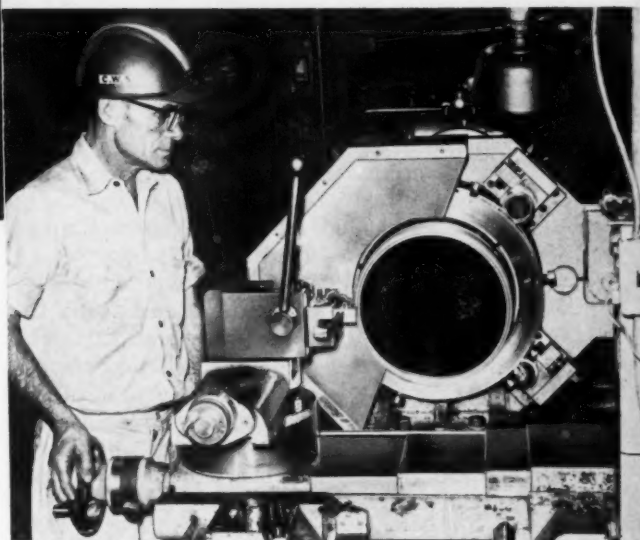
A single unit is selected at random from a specified number of production lots and transferred to a hydrostatic test chamber (Fig. 9), where it is sealed and filled with water. Increasing pressure is then applied until it bursts. This test provides both a close quality control and a reliability check of both the production process and the materials to help assure proper operation of the missile in the field.

A bevel ring gear is provided at the junction of the aft end of the nozzle with the nozzle extension. This gear serves to rotate the missile on the launching rail. The assembly is also equipped with a safety feature (attached to the nozzle) which will neutralize the thrust in the event of unintentional firing. This thrust neutralizer must be removed prior to the placement of the missile



Fig. 4. Here, the motor-case blank is undergoing the third and final pass in the shear-forming machine. This cold-working eliminates any need for subsequent heat-treatment.

Fig. 5. The missile case is automatically chucked, centralized, cut to length, and contour-turned at the forward end in this specially equipped lathe.



on the launching rail. In addition to careful inspection throughout the production and assembly processes, the completed rocket motor is placed in a special fixture for determining the exact and precise center of gravity.

The assembly is then moved to a functional acceptance test fixture which checks conformance to engineering requirements. This latter fixture, operated by a qualified inspector, serves to determine the horsepower for rotating the rocket at a

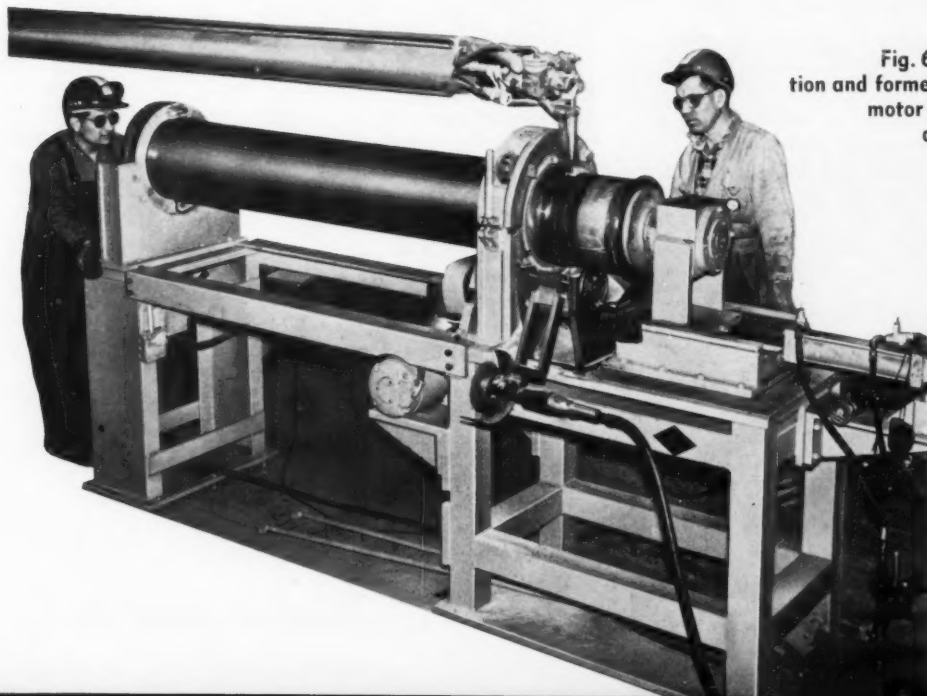
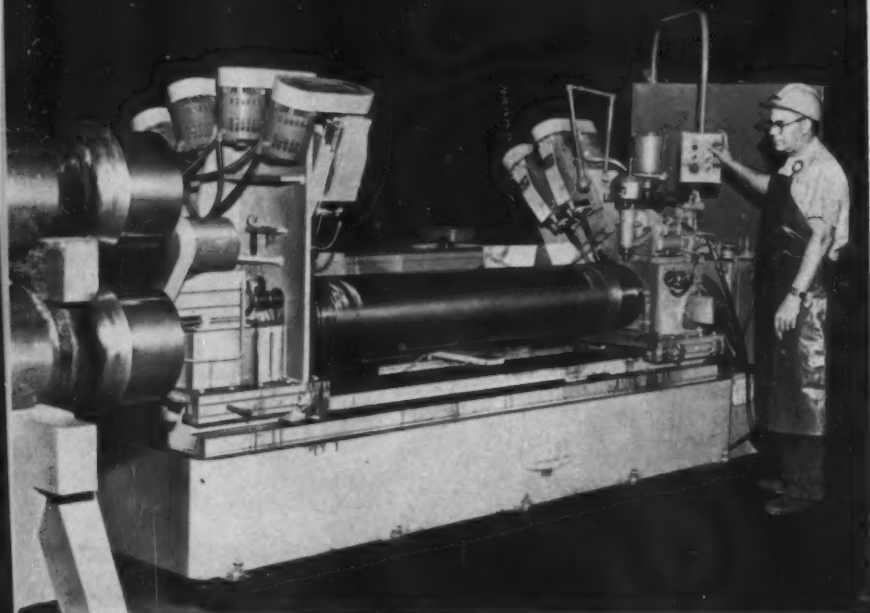


Fig. 6. Here, the pedestal section and formed head are welded to the motor case by the submerged-arc process. Each weld is X-rayed 100 per cent.



given speed, simulating the launching. This reflects the accuracy of the assembly. The fixture also simulates the various inclination angles of the launching rail, and functional acceptance tests are performed at each attitude.

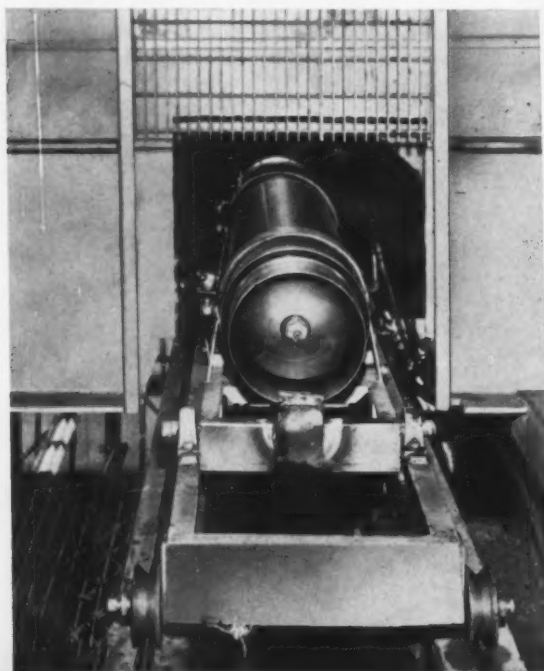
Additional components such as grain immobilizers and suppressors are also manufactured and assembled into the rocket, and each motor-case assembly is carefully weighed to an accuracy of 1/4 of 1 per cent. In conformance with inspection requirements, every dimension of the motor-case assembly is recorded and retained as a permanent record. After acceptance, each motor is placed in a special metal shipping and storage container made for the rocket at the plant.



Fig. 7. (Top) Automatic drilling and tapping machine used in the production of three major components of the Littlejohn missile.

Fig. 8. (Center) Boring is seen here being accomplished in one of five machining operations performed on the forged nozzle under automatic control.

Fig. 9. (Bottom) This missile case has been selected at random from a certain number of parts and prepared for burst testing.



Tables simplify hobbing of prime-number gears

R. A. PITMAN

THERE IS OFTEN a reluctance to specify spur gears with a prime number of teeth, apparently because of the difficulty in indexing for these numbers. This is especially true for prime-number tooth gears having more than 100 teeth. Spur gears of this type, however, can readily be cut on hobbing machines equipped with differential gearing for obtaining helical-gear leads.

When such machines are used, the regular index change-gears can be chosen to cut the work-gear teeth at a very slight helix angle. The differential lead gearing can then be selected so that the cutter will follow the same angle, but in the opposite direction. This compensates for the angle introduced by the index-gearing, and the resultant teeth are cut at right angles to the plane of the gear. In other words, the differential gearing normally employed to obtain the lead in helical gears is used to cancel a small discrepancy purposely introduced in the indexing-gearing to permit the cutting of prime-number spur gears using only readily available gears in the indexing train.

The accompanying tables of index ratios were compiled to simplify the change-gear calculations necessary for cutting gears having prime numbers of teeth in the range between 31 and 400 teeth when differential gear hobbers are used in the manner described. The table could be extended to prime numbers above 400, but this limit appears to be reasonable for practical purposes.

The equations for obtaining the index- and lead-gearing ratios are as follows:

$$\text{Index ratio} = \frac{C \times F}{(P \times F) \pm 1} = \frac{C \times F}{f_1 \times f_2}$$

(Obtain index ratio from last column of tables.)

$$\begin{aligned} \text{Lead-gear ratio} &= \frac{L_c}{\text{lead per tooth}} \\ &= \frac{L_c}{\text{feed per revolution} \times F} \end{aligned}$$

where: P = prime number to be indexed
 C = machine indexing constant
 L_c = machine lead-gearing constant
 F, f_1, f_2 = factors defined in tables

Both the indexing constant C and the lead-gearing constant L_c are determined by the particular machine used. The feed per revolution is selected from the tables on the machine giving the available feeds and the gears to use to obtain these feeds. Lead and feed gears must necessarily be locked-in during the entire operation to avoid

damage to the blank. The following examples show how the tables may be used as an aid for selecting the gearing for hobbing prime-number tooth gears on a machine with an assumed indexing constant C of 24, a lead-gearing constant L_c of 1, and a feed per revolution of 0.05 inch.

Example 1: Find the index- and lead-gearing ratios for hobbing a 137-tooth gear.

Solution: The index-gear ratio from the values given in the table for 137 teeth is:

$$\frac{C \times 35}{51 \times 94} = \frac{24 \times 35}{51 \times 94}$$

for the machine to be used. This ratio is actually for cutting 136 34/35 teeth.

The lead-gear ratio to compensate for the difference D ($-1/35$) is:

$$\begin{aligned} &\frac{L_c}{\text{feed per revolution} \times F} \\ &= \frac{1}{0.05 \times 35} = \frac{1}{1.75} = \frac{4}{7} = \frac{24}{42} \end{aligned}$$

Since the difference D is negative, the lead gears must be set as if to produce a helical gear having a helix of the opposite hand to that of the hob being employed. Use of a single-lead hob in this case is indicated by the table.

Example 2: Find the gearing ratios for hobbing a 263-tooth gear.

Solution: From the values in the table for 263 teeth, the index ratio to be used is:

$$\frac{C \times 32}{61 \times 69} = \frac{24 \times 32}{61 \times 69}$$

for the same machine. This index ratio is actually for cutting 131 17/32 teeth, since a double-lead hob is to be used.

The lead-gear ratio to compensate for the difference D ($+1/32$) is:

$$\begin{aligned} &\frac{L_c}{\text{feed per revolution} \times F} \\ &= \frac{1}{0.05 \times 32} = \frac{1}{1.6} = \frac{5}{8} = \frac{30}{48} \end{aligned}$$

As D is positive, the lead gears must be set as if to cut a helical gear having a helix of the same hand as the hob to be employed. Use of a double-lead hob is indicated by the table.

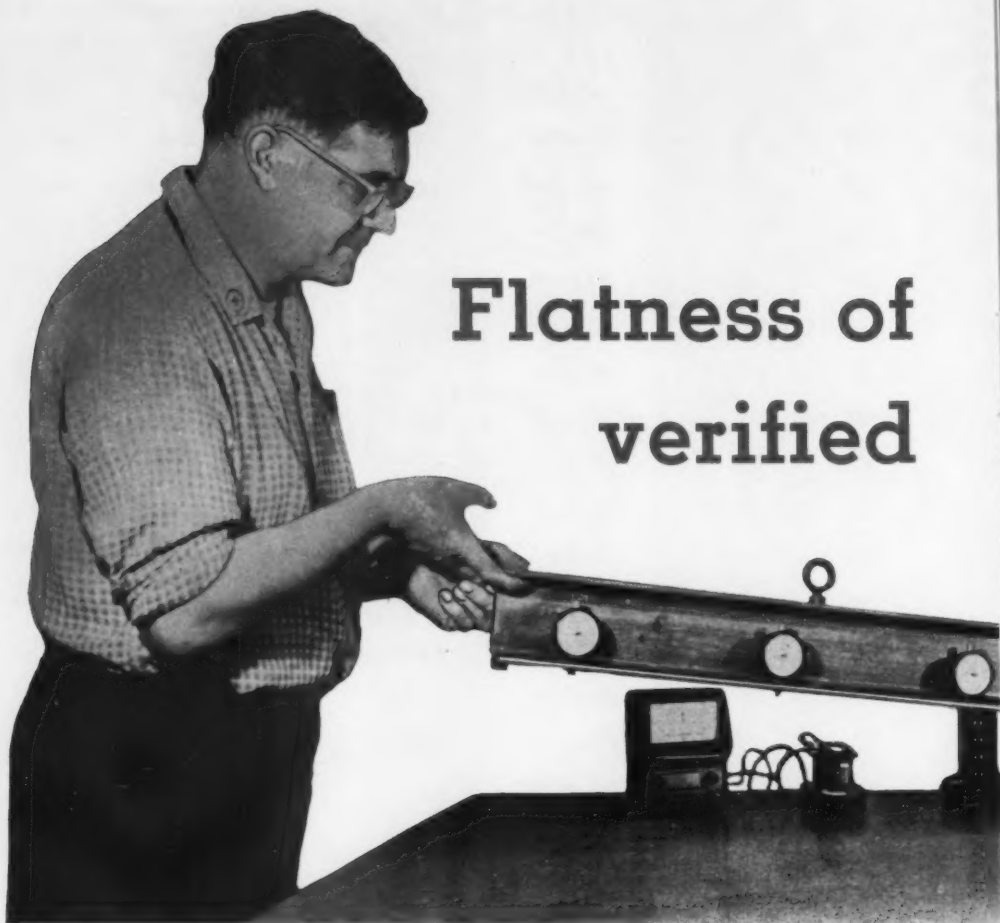
Data for using three- or four-lead hobs can be obtained by calculating an indexing ratio for 1/3 or 1/4 the number of teeth desired, plus or minus a small fractional difference D . The factor F should yield a number $(P \times F) \pm 1$ that is conveniently factorable into $f_1 \times f_2$. In addition, F should not be less than 30, and preferably greater to avoid heavy loading of the lead gears.

Tables that Simplify Calculation of Index and Lead Gearing for Cutting Spur Gears with Prime Numbers of Teeth on a Differential Gear-Hobbing Machine: Table 1. For a Single-Lead Hob

Prime Number P	Number to Index for N	Difference D $= N - P$	Factor F $= \frac{1}{D}$	$(P \times F) \pm 1 = f_1 \times f_2$		Index Ratio $\frac{C \times F}{(P \times F) \pm 1} = \frac{C \times F}{f_1 \times f_2}$
31	36 33/34	- 1/34	34	1053	27 × 39	$\frac{C \times 34}{27 \times 39}$
37	37 1/38	+ 1/38	38	1407	21 × 67	$\frac{C \times 38}{21 \times 67}$
41	41 1/39	+ 1/39	39	1600	32 × 50	$\frac{C \times 39}{32 \times 50}$
43	43 1/41	+ 1/41	41	1764	28 × 63	$\frac{C \times 41}{28 \times 63}$
47	47 1/37	+ 1/37	37	1740	30 × 58	$\frac{C \times 37}{30 \times 58}$
53	52 36/37	- 1/37	37	1960	35 × 56	$\frac{C \times 37}{35 \times 56}$
59	59 1/37	+ 1/37	37	2184	26 × 84	$\frac{C \times 37}{26 \times 84}$
61	60 36/37	- 1/37	37	2256	24 × 94	$\frac{C \times 37}{24 \times 94}$
67	67 1/35	+ 1/35	35	2346	46 × 51	$\frac{C \times 35}{46 \times 51}$
71	71 1/37	+ 1/37	37	2628	36 × 73	$\frac{C \times 37}{36 \times 73}$
73	72 36/37	- 1/37	37	2700	36 × 75	$\frac{C \times 37}{36 \times 75}$
79	79 1/37	+ 1/37	37	2924	34 × 86	$\frac{C \times 37}{34 \times 86}$
83	83 1/37	+ 1/37	37	3072	48 × 64	$\frac{C \times 37}{48 \times 64}$
89	89 1/37	+ 1/37	37	3294	54 × 61	$\frac{C \times 37}{54 \times 61}$
97	96 36/37	- 1/37	37	3588	46 × 78	$\frac{C \times 37}{46 \times 78}$
101	101 1/37	+ 1/37	37	3738	42 × 89	$\frac{C \times 37}{42 \times 89}$
103	103 1/38	+ 1/38	38	3915	45 × 87	$\frac{C \times 38}{45 \times 87}$
107	107 1/37	+ 1/37	37	3960	60 × 66	$\frac{C \times 37}{60 \times 66}$
109	109 1/31	+ 1/31	31	3380	52 × 65	$\frac{C \times 31}{52 \times 65}$
113	113 1/34	+ 1/34	34	3843	61 × 63	$\frac{C \times 34}{61 \times 63}$
127	126 30/31	- 1/31	31	3936	41 × 96	$\frac{C \times 31}{41 \times 96}$
131	130 30/31	- 1/31	31	4060	58 × 70	$\frac{C \times 31}{58 \times 70}$
137	136 34/35	- 1/35	35	4794	51 × 94	$\frac{C \times 35}{51 \times 94}$
139	139 1/30	+ 1/30	30	4171	43 × 97	$\frac{C \times 30}{43 \times 97}$
149	148 34/35	- 1/35	35	5214	66 × 79	$\frac{C \times 35}{66 \times 79}$
151	150 30/31	- 1/31	31	4680	52 × 90	$\frac{C \times 31}{52 \times 90}$
157	157 1/32	+ 1/32	32	5025	67 × 75	$\frac{C \times 32}{67 \times 75}$
163	163 1/30	+ 1/30	30	4891	67 × 73	$\frac{C \times 30}{67 \times 73}$
167	166 32/33	- 1/33	33	5510	58 × 95	$\frac{C \times 33}{58 \times 95}$
173	173 1/37	+ 1/37	37	6402	66 × 97	$\frac{C \times 37}{66 \times 97}$
179	178 29/30	- 1/30	30	5369	59 × 91	$\frac{C \times 30}{59 \times 91}$
181	180 29/30	- 1/30	30	5429	61 × 89	$\frac{C \times 30}{61 \times 89}$
191	190 30/31	- 1/31	31	5920	74 × 80	$\frac{C \times 31}{74 \times 80}$

Table 2. For a Double-Lead Hob

Prime Number P	$\frac{P}{3}$	Number to Index for N	Difference D $= N - P$	Factor F $= \frac{1}{D}$	$(P \times F) \pm 1 = f_1 \times f_2$		Index Ratio $\frac{C \times F}{(P \times F) \pm 1} = \frac{C \times F}{f_1 \times f_2}$
193	96 1/2	96 15/32	- 1/32	32	3087	49 × 63	$\frac{C \times 32}{49 \times 63}$
197	98 1/2	98 16/34	- 1/34	34	3348	54 × 62	$\frac{C \times 34}{54 \times 62}$
199	99 1/2	99 17/32	+ 1/32	32	3185	49 × 65	$\frac{C \times 32}{49 \times 65}$
211	105 1/2	105 15/32	- 1/32	32	3375	45 × 75	$\frac{C \times 32}{45 \times 75}$
223	111 1/2	111 14/30	- 1/30	30	3344	44 × 76	$\frac{C \times 30}{44 \times 76}$
227	113 1/2	113 14/30	- 1/30	30	3404	46 × 74	$\frac{C \times 30}{46 \times 74}$
229	114 1/2	114 15/32	- 1/32	32	3663	37 × 99	$\frac{C \times 32}{37 \times 99}$
233	116 1/2	116 16/30	+ 1/30	30	3496	46 × 76	$\frac{C \times 30}{46 \times 76}$
239	119 1/2	119 14/30	- 1/30	30	3584	56 × 64	$\frac{C \times 30}{56 \times 64}$
241	120 1/2	120 25/48	+ 1/48	48	5785	65 × 89	$\frac{C \times 48}{65 \times 89}$
251	125 1/2	125 15/32	- 1/32	32	4015	55 × 73	$\frac{C \times 32}{55 \times 73}$
257	128 1/2	128 14/30	- 1/30	30	3854	47 × 82	$\frac{C \times 30}{47 \times 82}$
263	131 1/2	131 17/32	+ 1/32	32	4209	61 × 69	$\frac{C \times 32}{61 \times 69}$
269	134 1/2	134 20/38	+ 1/38	38	5112	71 × 72	$\frac{C \times 38}{71 \times 72}$
271	135 1/2	135 15/32	- 1/32	32	4335	51 × 85	$\frac{C \times 32}{51 \times 85}$
277	138 1/2	138 14/30	- 1/30	30	4154	62 × 67	$\frac{C \times 30}{62 \times 67}$
281	140 1/2	140 16/30	+ 1/30	30	4216	62 × 68	$\frac{C \times 30}{62 \times 68}$
283	141 1/2	141 16/34	- 1/34	34	4810	65 × 74	$\frac{C \times 34}{65 \times 74}$
293	146 1/2	146 18/34	+ 1/34	34	4982	53 × 94	$\frac{C \times 34}{53 \times 94}$
307	153 1/2	153 16/30	+ 1/30	30	4606	49 × 94	$\frac{C \times 30}{49 \times 94}$
311	155 1/2	155 14/30	- 1/30	30	4664	53 × 88	$\frac{C \times 30}{53 \times 88}$
313	156 1/2	156 16/34	- 1/34	34	5320	56 × 95	$\frac{C \times 34}{56 \times 95}$
317	158 1/2	158 16/30	+ 1/30	30	4756	58 × 82	$\frac{C \times 30}{58 \times 82}$
331	165 1/2	165 14/30	- 1/30	30	4964	68 × 73	$\frac{C \times 30}{68 \times 73}$
337	168 1/2	168 16/30	+ 1/30	30	5056	64 × 79	$\frac{C \times 30}{64 \times 79}$
347	173 1/2	173 15/32	- 1/32	32	5551	61 × 91	$\frac{C \times 32}{61 \times 91}$
349	174 1/2	174 16/30	+ 1/30	30	5236	68 × 77	$\frac{C \times 30}{68 \times 77}$
353	176 1/2	176 16/34	- 1/34	34	6000	75 × 80	$\frac{C \times 34}{75 \times 80}$
359	179 1/2	179 17/36	- 1/36	36	6461	71 × 91	$\frac{C \times 36}{71 \times 91}$
367	183 1/2	183 14/30	- 1/30	30	5504	64 × 86	$\frac{C \times 30}{64 \times 86}$
379	189 1/2	189 18/38	- 1/38	38	7200	80 × 90	$\frac{C \times 38}{80 \times 90}$
383	191 1/2	191 18/34	+ 1/34	34	6512	77 × 88	$\frac{C \times 34}{77 \times 88}$
389	194 1/2	194 17/32	+ 1/32	32	6225	75 × 83	$\frac{C \times 32}{75 \times 83}$
397	198 1/2	198 15/32	- 1/32	32	6351	73 × 87	$\frac{C \times 32}{73 \times 87}$



Flatness of verified

The lapping for large parts for the national defense calls for flatness controlled to 50 millionths of an inch on a 7-foot table. A simple but effective tool that is easy to build removes uncertainty regarding table accuracy

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THE greatest degree of flatness feasible in a work-piece is directly proportional to the flatness of the lapping machine table. The general-purpose job shop of General Electric's Pittsfield Ordnance Department had to revise its methods of verifying flatness when the company's engi-

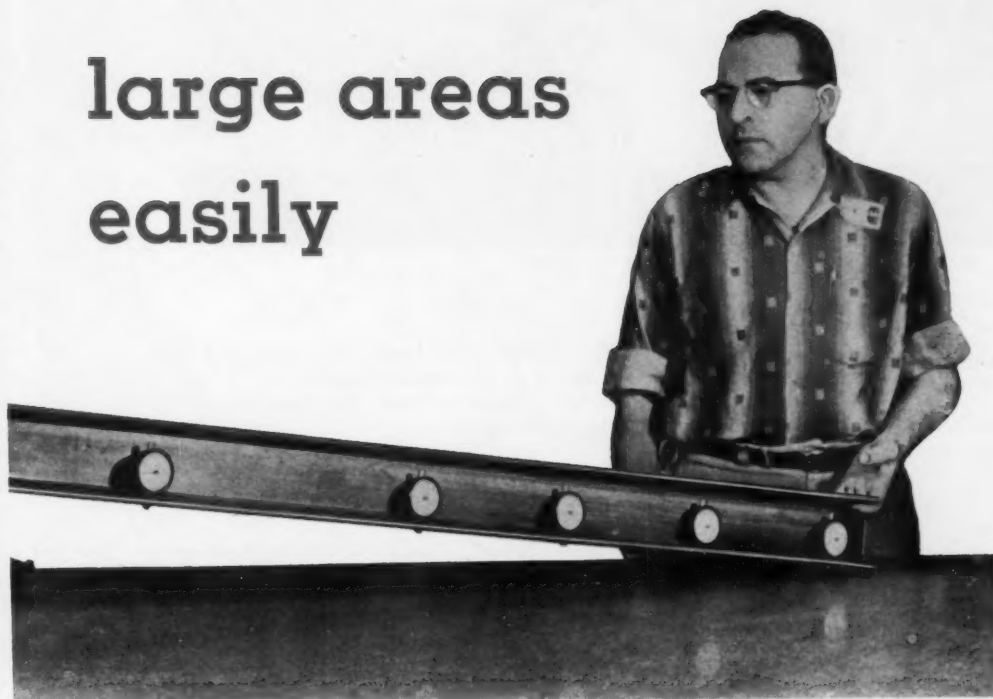
neering staff asked for a minimum of 50 millionths of an inch on part faces 84 inches in diameter.

The production department found that making such large parts precisely flat required a different procedure in checking the table of its Lapmaster machine. When an indicator was used to check the table, its flatness did not compare with the results obtained optically by light-band readings.

On smaller parts the department had previously used a fused quartz optical flat, 10 inches in diameter, to inspect the flatness of the lapping machine table. The procedure required using three heavy brass discs, 8 inches in diameter. The discs were run within a cage which revolved inside of the conditioning rings on the lapping machine. After the disc faces were completely lapped they were removed, washed, and placed beneath the optical flat. Using a monochromatic light, the discs were checked. The results were interpreted as the flatness of the table.

As long as production parts approximating the face area of the brass discs were the top size limit lapped on the Lapmaster machine, this verification method worked very well. But when parts as

large areas easily



large as 84 inches in diameter were required, the scope of the lapping operation obviously was different. The old method was no longer adequate, as proved by checking the table by indicator. Flatness did not compare with light-band readings. Many alternatives were discussed and attempted for checking the flatness of the lapping table. The straightedge method proved insufficiently accurate. Auto-collimation worked, but was too slow.

The solution was found in the development of a beam type checking bar because it met the joint demands of accuracy and speed, Fig. 1. The bar is made from a structural aluminum I-beam 86 inches long, 2 3/4 inches wide, by 3 1/2 inches high with a 5/16-inch web thickness. Three holes are tapped in the bottom flange to accommodate three hardened spherical feet. The face of the beam adjacent to the tapped holes is counter-bored to give the feet a flat shoulder surface. Then the individual feet are ground to level the bar.

The feet are spaced triangularly on the bar so that the distance between the center lines of the two on one end is 84 inches from the single foot at

the opposite end (or the same as the diameter of the table to be checked, Fig. 2). The vertical web of the beam is drilled and slotted for each of the eight indicators, with a clearance hole through the bottom flange of the beam to permit the contactor of each indicator to touch the work surface. The indicators are fastened to the vertical web by shoulder screws, Fig. 3. The indicators are spaced 10 inches apart, Fig. 5. After assembly of the bar, the first problem was to establish a reference for flatness. This was accomplished by auto-collimating the department's 5- by 8-foot Herman granite surface plate. The readings were plotted to determine which portion of the plate was the flattest. This plate was found flat within 0.0003 inch over its entirety, but inspection on one diagonal proved to be within 50 millionths of an inch. Therefore, this path became the reference point. The engineers next set the checking bar across the diagonal reference point on the granite table (Fig. 1) and proceeded to preload each indicator. This was done by sliding the indicator up or down in its slot on the beam until the contactor barely touched the granite plate. Then it was preloaded

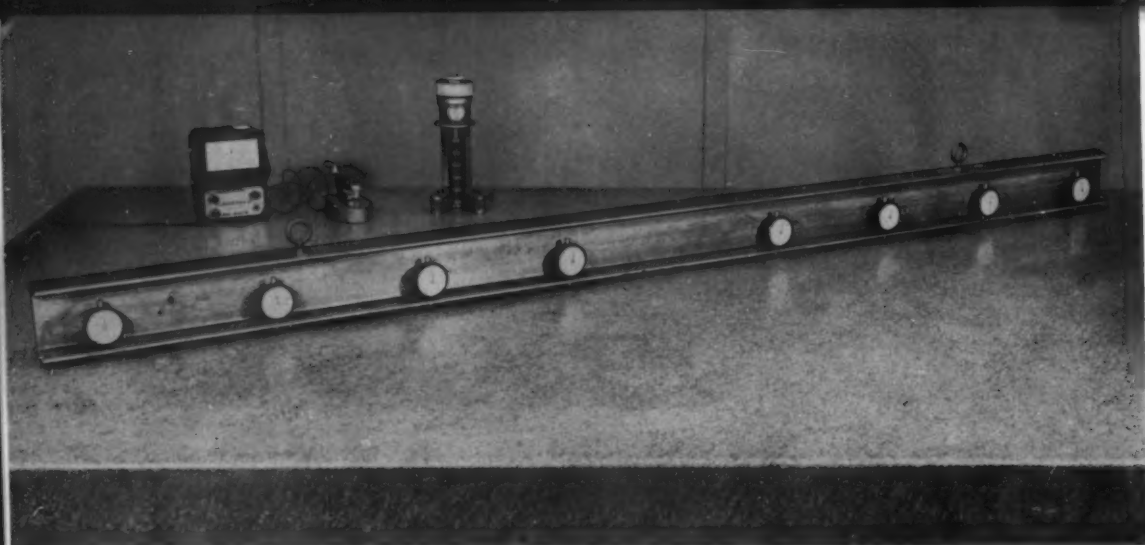


Fig. 1. (Above) The beam-style checking bar is zeroed-in on a special granite surface plate before and after checking the lapper table.

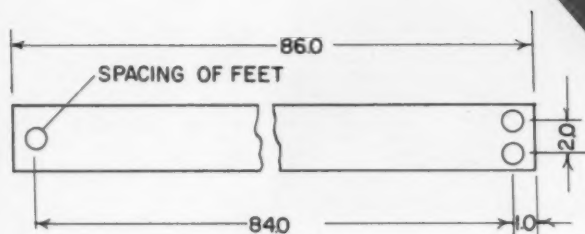


Fig. 2. Three-point arrangement of the feet permits fast setting of the indicators and good repeatability in results.

to half the travel of the indicator needle (0.0010 inch). After all indicators were preloaded, the dial faces were adjusted so that they read 0. Fig. 6. All indicators used were Model C-21, graduated in ten thousandths of an inch, furnished by Federal Products Corporation, Providence, R. I.

To insure that all indicators function properly and to get a repeatability average, the operators raise the beam from the granite plate before taking a reading so that the indicators are not in contact. By lifting and setting it back down in the reference area a few times, a reference for beam flatness can be established.

Lifting the bar, single-foot end first, until all pressure is off the mechanism of the indicators, and afterward lifting the double-foot end, assures that no tipping action will take place that could change any indicator reading. This is a two-man operation (heading illustration).

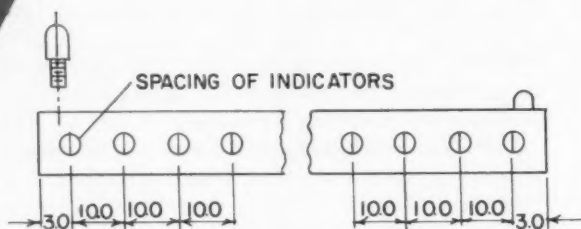
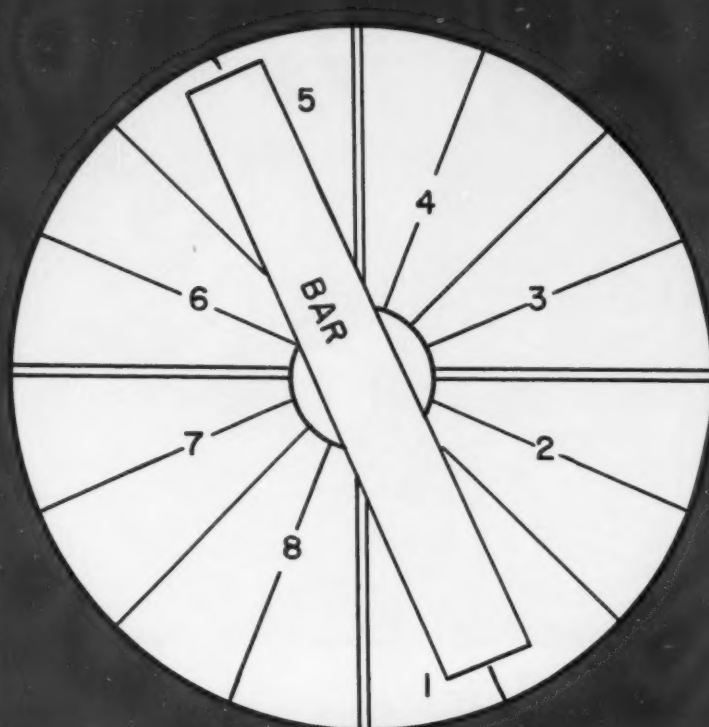


Fig. 3. The indicators are spaced 10 inches apart, starting at the feet, from each end. Foot for the checking bar (above) has hardened rounded nose and shank threaded to a shoulder.

The bar is now ready to be set on the lapping table, which in the meantime has been thoroughly washed with a solvent to remove all oil and swarf residue, Fig. 7. Again the double-foot end of the



LAPPER SEGMENT READINGS-1 AND 5		
	DATE AND TIME	
	7AM	9AM
1	+ .0002	+ .0005
2	+ .0001	+ .0005
3	0000	0000
4	0000	0000
5	0000	0000
6	0000	0000
7	+ .0001	+ .0005
8	+ .0002	+ .0005

Fig. 4. A typical history of the use of the beam is the chart at the right. The reading at 7 A.M. shows the table a little concave. The conditioning rings were moved outward 0.250 inch, and in two hours the table was flat within 0.00015 inch and suitable for lapping a part to within 0.000050 (50 millionths) inch.

bar is set down first and then the single-foot end. A reading is taken and documented on a plan sheet which shows each segment of the table, Fig. 4. The bar is lifted and set down on each segment until a complete flatness reading has been made on diameters at all segments. A set of typical readings is charted at the right of the sketch.

As reassurance that the readings that have been taken are accurate, the operators always go

back to the granite reference plate and recheck the bar. If the indicators all read 0, they know that the lapping table has the accuracy shown. On routine production only one diameter on the table is checked. For example, segments No. 1 and No. 5 are checked to give an average reading for the whole table. The frequency of inspection is in direct relation to the hours of running time. Normally a check every two hours of actual lapping

Fig. 5. Feet and indicator plungers are simply arranged on the bottom of the checking bar. One foot is on the left-hand end and the other two are at the right.

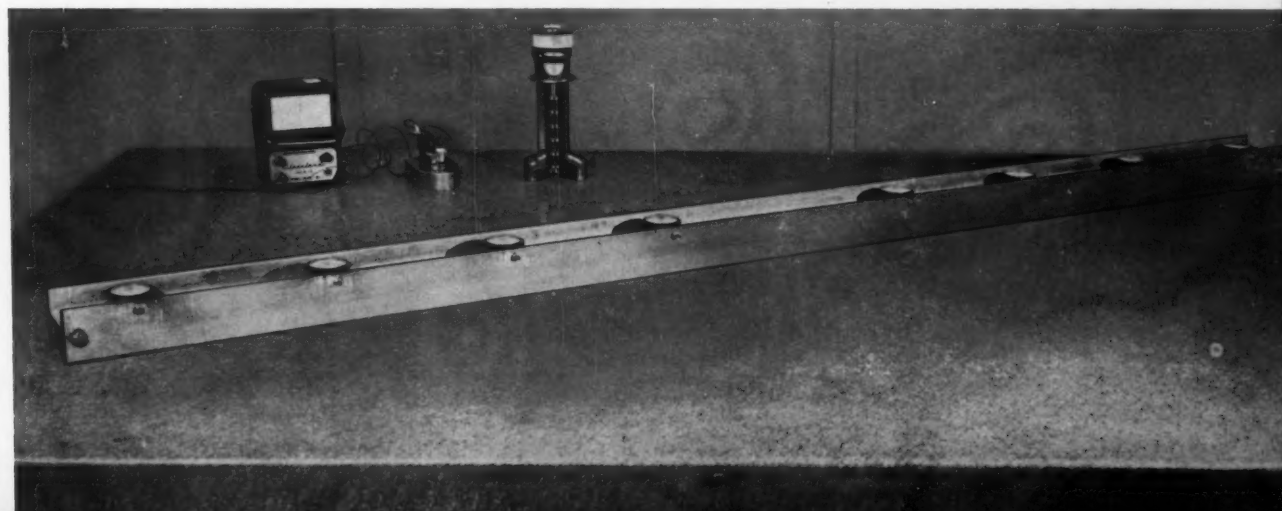
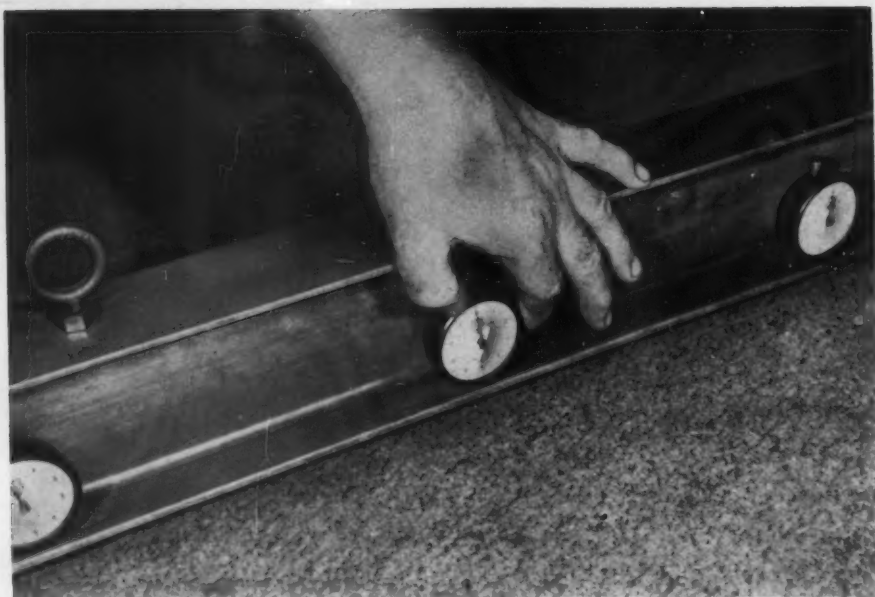


Fig. 6. With the bar standing on its three feet the preloaded indicator is easily zeroed-in.



time is adequate. But when erratic readings appear, then all the segments are inspected 100 per cent.

To correct concave or convex contour of the table top, the operator simply moves the conditioning rings—outward radially from the center of the table, to correct a concave condition; and in toward the hub, to correct a convex condition. The distance the ring is moved is small, usually 0.250 inch at a time. Conditioning the lapping table top to achieve the specified degree of accuracy is a slow and tedious procedure. To correct a convex or concave condition of only 0.0005 inch sometimes takes sixteen hours of running. This is one of the reasons for inspecting the table flatness frequently during operation.

In this department, practice has proved that if table flatness is controlled to within 0.00015 inch in 84 inches, part flatness will be held to ± 0.000025 , (25 millionths) inch regardless of the size of the lapped surface. The only limitation, of course, is the diameter of the table top.

The optimum situation for attaining a high degree of flatness, obviously, is when the work-piece can be caged within the conditioning ring, so that conditioning of the table proceeds concurrently with the lapping of a part. It has been found advantageous, in keeping the table flat, to run one or more conditioning rings "dead head" even when parts of considerable size are being lapped. The lapping machine is built by the Lapmaster Division, Crane Packing Co., Morton Grove, Ill.

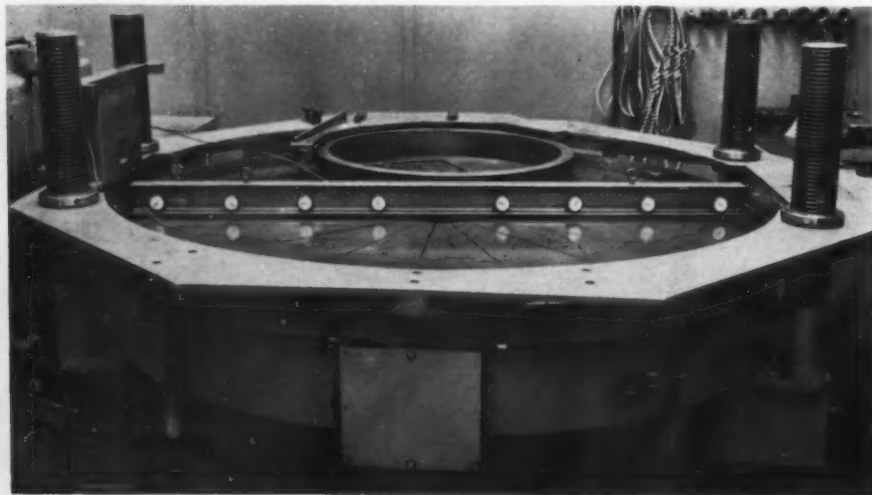


Fig. 7. Control of lapping machine table flatness is maintained using the checking bar to span the table. At the rear of the table is a conditioning ring.

CONDENSED REVIEW OF SOME RECENTLY DEVELOPED MATERIALS

Arranged alphabetically by trade names

Material	Trade Name	Properties	Applications
Stainless Alloy	ACI Type CD-4MCu	This precipitation-hardenable stainless alloy has a tensile strength of 110,000 psi and a yield strength of 85,000 psi.	Has been used to make the breech-door castings on the latest type of nuclear submarine.
Welding Wires	Airco Welding Wires	These stainless-steel wires provide the close control of the amount of ferrite in the weld deposit, lack of which could result in weld cracking, and the excess of which could reduce the mechanical properties.	For the submerged-arc welding of 308, 309, 310, 347, and 502 stainless steel.
Epoxy Resins	Allaco Foundcast 101, Sandbind 201, Facecoat 301, Multicast 401	This complete line of epoxy resins have various properties such as dimensional stability, good machinability, etc., for specific uses.	Used in the foundry and tooling industries for making molds and patterns, and also jaws and chucks.
Composite Tubing	Allegheny Ludlum Composite Tubing	This tubing has an inside lining of stainless steel and an outside casing of carbon steel—the stainless steel providing the corrosion resistance, and the carbon steel providing the fabricability.	May be used in nuclear reactors to carry the cooling medium for the fuel system.
All-Metal Honeycomb	Allied All-Metal Honeycomb	This material may be made into any number of shapes or curves of almost any size. It may also be manufactured with load bearing inserts and mounting brackets.	It is intended for use in the aircraft, missile, and space-vehicle field, and may be welded using ordinary welding techniques.
Brazing Alloy	All-State Bright Finish No. 23	A low-temperature, phosphor-copper silver-brazing rod which produces 50,000-psi tensile-strength bonds.	Recommended for joining all copper alloys by all standard brazing methods.
Diffusion Process	Alphatizing	This process increases the resistance of carbon steel to heat corrosion and wear by supplying an adequate and controlled amount of chromium to the surface of the carbon steel in the form of a true alloy.	Applications include jet-engine vanes, truck mufflers, strip heater casings, communication relay parts, and can-seamer rolls.
Coated Wire	Alstan	This aluminum-coated steel wire exhibits good strength, electrical-conductivity, and corrosion-resistance properties.	Useful as a material for power transmission lines.
Lubricant	Anchorlube	This lubricant contains no oil, is odor-free and harmless to the skin.	Used in drilling, tapping, spot-facing, etc., metals, such as stainless steel, high-carbon steel, high-chromium steel, cast iron, and Monel.
Columbium-Bearing Steels	Armeo High-Strength No. 6 and No. 7	These high-strength, low-alloy steels have yield points of 50,000 and 45,000 psi, respectively. Corrosion resistance is equivalent to mild noncopper-bearing steels. Can be simply bent across the rolling direction, flanged, and lightly formed.	Available as plates, hot-rolled sheets, and hot-rolled strip for applications requiring high strength, weldability, and simple formability.
Fasteners	Beryllium Fasteners	These fasteners are one-fourth the weight of steel and nearly twice as strong as comparable steel fasteners on a strength-to-weight basis.	They are being offered for satellite and missile applications.

For names and addresses of manufacturers of products listed, see end of this section

Review of some recently developed materials (continued)

Material	Trade Name	Properties	Applications
Machining Fluid	B/G No. 505	A base which is a combination of emulsifiers, surface actives, and oiliness agents. A mineral oil blend which makes a stable white emulsion in water and has a high resistance to bacterial growth.	Used for sinking aluminum chips, and prevents caking of aluminum fines in machining and grinding operations.
Machining Compound	B/G No. 576	This compound possesses high film strength, good wetting ability, and corrosion-prevention characteristics, as well as being nontoxic and immune to bacterial action.	It has been used in spline rolling, broaching, and similar applications.
Tungsten Carbides	CA-704, CA-711, CA-720	These cemented tungsten carbides are shock- and wear-resistant and their use is said to extend tool life up to 200 per cent.	Can handle jobs ranging from fine finishing and precision boring to heavy and interrupted cutting.
Tool Steel	Carpenter Vega (AISI Type A-6)	This air-hardening tool steel does not move out-of-round appreciably in heat-treating operations.	Used for numerous tooling set-ups.
Adhesives	Chemlok 220 and 203	These products bond uncured elastomers to any metal to produce a rubber-tearing bond.	For the production of rubber grinding and polishing contact wheels and rolls.
Metal Primer	Clo-Flex 621	A metal primer which provides coverage to all metal surfaces—particularly over weldments, sharp edges, and other protuberances; is impervious to salt and chemical attack; and is abrasion and chip resistant.	Is suitable for primer uses on most metals and has been used for coating rubber, wood, and other materials as well.
Gasket Material	Cohrlastic	A silicone-rubber and metal material used for conductive gasketing purposes, which conforms easily to irregular surfaces and is impervious to fluids.	Suitable for making ignition harnesses and quick disconnect plugs. Also used as wave-guide gasketing and as shielding between magnetos and their bases.
Ceramic Powders	Corcast, Cortamp	Two ceramic powders that can be formed into shapes for use in hot tooling. No separate firing is required, since bonding occurs in use.	Can be used to make tools, jigs, and fixtures in the aircraft and missile industry.
Tin Coating	Cuposit LT-26	This tin coating for metal surfaces is applied at temperatures much lower than those for the hot-tin dip process. It does not require the use of electricity and contains no cyanide.	It is used on printed circuits, outlets, connectors and plugs, component leads, and other electronic hardware.
Tool Steel	Dargraph	An oil-hardening graphitic tool steel of an AISI-SAE Type O6 designation with outstanding resistance to abrasive wear, galling, scuffing, and scoring.	Used for making wear plates; gages; and blanking, piercing, and cutting dies.
Plastic Film	Durethene Polyethylene Film	This film comes in unseamed widths up to 40 feet and is cheaper than canvas, but tears easily when placed over a sharp projection.	Used for conveniently and economically protecting machine tools in shipment. Sharp projections are first covered with reinforced papers.
Elastomer	Elastine	This material outwears rubber and withstands a torque load.	Designed specifically for flexible coupling inserts.

Review of some recently developed materials (continued)

Material	Trade Name	Properties	Applications
Stripping Agent	Enstrip NP	This nonfuming, alkaline, cyanide-free stripper does not decompose when left idle for long periods of time.	For removing nickel from steel, copper, brass, and other copper alloys.
Adhesive	Epoxi-Patch No. 0151	Can be used to join glass to glass, Pyroceram to glass, and metal to glass.	For general-purpose joining and repairing printed circuits and strain gages.
Alloy-Steel Bar	e.t.d. 150	A high-tensile-strength alloy-steel bar that takes the place of quenched and tempered bar steels and eliminates heat-treating and costly secondary operations.	Recommended for shafts, gears, pinions, fasteners, axles, and other parts to replace heat-treated alloy steels.
Ceramic-Fiber Paper	Fiberfrax	An alumina-silica fiber material that is lightweight yet physically strong, and capable of continuous use at temperatures up to 2300 degrees F.	Provides protection during brazing operations in that it may be placed on a conveyor belt or fixture, under the parts being brazed.
Fiberglas Lamp	Fluorescent	This lamp gives the appearance of a gas flame in an electric bulb and is shatter-proof.	Used where a shatterproof lamp would be beneficial.
Fiberglas Fabric	Flexaust GlasHose	This neoprene-coated fiberglas fabric, which is spiral-wire reinforced, has flame resistance and a high burst strength.	The hose is designed for air-handling and fume-control applications in an operating temperature range of -40 to +300 degrees F.
Plastic Jugs	Flex-O-Boys	These shatterproof, corrosion-resistant, 5-gallon polyethylene plastic jugs, when empty, take up one-third the space requirement of noncollapsible containers.	For storing or transporting virtually all kinds of liquids.
Carbon Electrode	Gentrode 10	This material, for use in electrical-discharge machining, is supplied in slab form. It may be machined to any desirable electrode shape, without flaking or chipping, with greater ease than leaded brass.	Not used up as fast as conventional brass electrodes, which makes possible use of shorter electrodes in electrical-discharge machining.
Die Steel	Hardtem	A chromium-molybdenum-vanadium alloy die steel that possesses toughness and shock-resistant qualities. It is resistant to abrasion, heat checking and cracking, and the effects of elevated temperatures.	Furnished in the prehardened condition, ready for sinking, it is useful for making dies for present-day drop-forging temperatures and production.
Aluminum Paint	Heat-Rem H-120A	This high-heat-resistant aluminum paint resists atmospheric exposure and the corrosive effects of acids and alkalies.	May be applied by dip, spray, or brush and sets to the touch in two hours.
Paint	Heat-Rem H-170 Super	A high-heat-resistant paint which protects steel jigs, fixtures, and formed products during brazing operations.	Used widely on torch weld jigs on which rocket-engine chambers are formed.
Burnishing Compound	Honite One-Twenty-Six	This burnishing compound is a free-flowing soap type powder that can frequently be used in small amounts in the cut-down cycle.	Devised to hold color in barrel-finishing zinc die castings.

Review of some recently developed materials *(continued)*

Material	Trade Name	Properties	Applications
Sheet Metal	Hydro-T-Metal	This is an alloy of zinc, copper, and titanium which retains all the basic advantages of zinc and also provides the structural strength, stability, and scope of the other nonferrous metals.	Useful for applications which require easy solderability, fusion welding, deep drawing, spinning, extruding, etc.
Casting Process	Impel Casting	This casting process results in yield strengths in cast products ranging from 25,000 to 100,000 psi.	For casting small titanium parts such as pump housings, impellers, valve bodies, and pump sleeves.
Tubing	J&L DOM Electricweld	This drawn-over-mandrel electric resistance-weld tubing facilitates manufacture to close tolerances with good concentricity, surface finish, and machinability.	Useful wherever resistance-weld tubing has been previously employed.
Hard-Facing Process	Kenspray	This hard facing, which is deposited to a depth of 0.060 inch, provides a long tool life.	Used for hard-surfacing grinder centers—in one instance permitting ten regrinds.
Vibration-Isolation Pad	Kinetic Isolation Pads	These fiberglass pads are prescored at 2-inch intervals for easy cutting to size. The elasticity of the glass fiber provides high internal damping for machine stability.	For isolating vibration and eliminating lagging machinery to the floor.
Damping Compound	Korfund Vibrodamper	This viscoelastic material which, when sprayed or troweled onto a metal plate, greatly reduces structurally borne noise and vibration, is acoustically equivalent to a sheet of cork.	Uses include sheet-metal applications such as air ducts, plenums, and metal doors.
Stainless Steel	Lesco BG 41 Vac Arc	A steel with good "hot hardness" which may be subjected to maximum compressive stresses of more than 600,000 psi at temperatures in excess of 800 degrees F.	Being used for bearing assemblies in a pneumatically controlled mechanism which reverses the forward thrust of aircraft engines.
Bearing Steel	Lesco BG 41, 42, and 43	These corrosion-resistant bearing steels exhibit hot-hardness properties and resistance to wear and oxidation.	For applications in bearings and structural components in jets and missiles.
Silicone Compound	LTV 602	This potting material provides protection against shock, vibration, moisture, ozone, and corona. It flows freely in and around complicated parts before curing.	Provides mechanical and dielectric protection for electronic components and assemblies.
Plastic-Clad Steel	Lukens Plastic-Clad Steel	This steel plate can be rolled into tanks or pipes, pressed into various shapes, and easily welded.	For piping, storage, and processing tanks for salt water, swimming pools, and hull plates for yachts.
Phototemplate-Layout Sheet	Magnesium Phototemplate and Layout Sheet	This very flat tooling material is supplied chemically treated with a chromium pickled surface ready for priming or coated with a primer of the user's choice.	Recommended for use for both diazo and blueprint methods of reproduction.
Nickel-Alloy Steel	Mar-aged Steel	An 18 per cent nickel-alloy steel with a yield strength in excess of 250,000 psi. It has good machining characteristics and is ductile. It can be readily welded, manually or automatically.	Used where high strength, toughness, and resistance to corrosion are required.

Review of some recently developed materials (continued)

Material	Trade Name	Properties	Applications
Maskant	Maskant S51K808	This chemical-milling maskant for stainless steel will resist etchant attack for eight hours at 140 degrees F.	Used in the aircraft and missile industries. Maskant may be quickly and easily stripped.
Tarnish Preventer	Metex Antitarnish M-667	This product provides temporary protection against tarnish in copper and brass. Protection is afforded in moist atmospheres, even when hydrogen sulphide is present.	It is added to the final water rinses after metal-finishing operations. It contains no chromates, oils, or waxes.
Nickel Stripper	Metex Nickel Stripper BR	A powder for immersion-stripping nickel from brass and copper. Little or no buffing is required before parts can be replated.	Provides a safe, fast, economical method of reclaiming nickel-plated, copper-base alloys and copper-plated die castings.
Screw-Machine Stock	Micro-Chip	This aluminum screw-machine stock is color-coded and chamfered at both ends, and exhibits good machining properties.	It offers fabricators a bright and clean surface, which is important in operations where no stock is removed.
Flat Stock	Milford Flat Stock	This precolored and oversized precision-ground flat stock is supplied in a deep blue-black color, ready for immediate scribing or layout work.	Used in making tools and parts where it is necessary to do finish work on the stock after forming and heat-treatment.
Cutting Fluids	Mobilmet Cutting Fluids	These fluids maintain high machining efficiency in different operations. They contain a phospho-sulphurized additive which controls the built-up edge on the cutting tool as pressure-temperature conditions change due to operations or metals.	Used to advantage in numerical-control machine tools and automatics that are required to handle many different jobs in rapid sequence.
Gear Compound	Molyube Open Gear, Gear-Kote, and B-R Geartex Compounds	Each is available in two types, one for hand, the other for spray application. The first is for heavily loaded open and semiopen gears; the second, for heavily loaded open gears; and the third, for protecting gears from "feathering" in abnormal shock loads.	Useful for all types of gear applications, high load, high heat, etc.
Nickel-Plating Process	N2E	This process offers uniformity of coating appearance, ease of control, and no harmful breakdown products.	For electroplating a coating of sulfur-free semibright nickel on metal surfaces.
Solder Type Alloy	Neu-Tec-Tronic 157 BN	This alloy can be applied with a soldering iron, torch, hot plate, or by induction heating. It has a low melting point and a high solidification rate.	For electrical and electronic work and assemblies.
Cemented Carbides	NewBide N-20, N-50, N-60, N-70, N-80	These cemented carbides have Rockwell A hardnesses ranging from 91.2 to 93 and have transverse rupture strengths ranging from 225,000 to 325,000 psi.	Used for machining a variety of materials with differing characteristics. Each grade has been designed for a specific condition and type of metal to be machined.
Brazing Alloys	Nitrobraz S Series	These brazing alloys, in the form of powders in high-viscosity vehicles, are said to reduce alloying time by 50 per cent.	Applied quickly and easily by a unique air-gun method for production work or by manual syringe for smaller jobs.

Review of some recently developed materials (continued)

Material	Trade Name	Properties	Applications
Inspection Material	No. 14M Magnaglo, No. 9BM Magnaflox, No. 1 Gray Powder	These ready-to-use magnetic-particle inspection materials are available in pressurized spray cans and plastic squeeze bottles.	Their use facilitates the field testing of parts of complex shape and eliminates the need for equipment for mixing regular formulas.
Spring Wire	NS-A286	A precipitation-hardening austenitic alloy for spring wire use in a temperature range of 600 to 1000 degrees F.	The material is finding initial application in jet engines and gas turbines.
Filled Nylon	Nylatron GS	This material is wear- and abrasion-resistant. It is molybdenum-disulphide filled.	Used for making nylon-filled thrust washers for roll-backing rolling-mill assemblies.
Nylon Gears	Nymet	These precision nylon cut gears with molded metal-insert hub have a strength factor which is said to be the same as that for metal gears using the Lewis formula, which assumes that the entire load is borne by a single tooth.	Available in sizes up to 3 inches in outside diameter and up to 1/2 inch in face width, they are offered for various uses.
Deburring Compound	Oakite FM 182	This compound combines moderate alkalinity with abrasives to deburr metals in tumbling barrels.	It is particularly recommended for severe cutting-down operations.
Burnishing Compound	Oakite FM 286	This burnishing compound is mildly acidic and produces a brilliant blue-white color on zinc die castings. It contains no soap and will leave no film.	Used for zinc, aluminum, steel, and most metals except magnesium.
Metal Cleaner	Oakite HD 126	This material, which has a pH of 13.5 at the recommended solution concentration, contains no resin or soap and is said to be completely rinsable.	For immersion cleaning of heavy and tenacious soils on steel, brass, and magnesium. Not recommended for aluminum and zinc.
Paint Stripper	Oakite Stripper 150	This stripper, which may be used in ordinary steel tanks, is safe on steel and magnesium and is inhibited against attack on aluminum, zinc, and brass.	For stripping acrylic, alkyd, and other resistant paint finishes.
Copper-Infiltrated Iron	Oilite (IM)	Strength and wear characteristics are comparable to 1045 steel.	This easily machinable material is used for making differential gears.
Die Steel	Orbit	This air-hardening die steel has a low hardening temperature, good machinability properties, is tough, and is dimensionally stable in the as-quenched condition.	This all-around tool steel (AISI Grade A-6) is used wherever an easily heat-treatable and free-machining die steel is needed.
Adhesive Process	PA-749 and PA-708	A two-step process for chemically "welding" nylon to metal by the use of an epoxy paste that chemically unites with the metal surface on which it is applied. A separate solvent softens the nylon surface so that it blends with the epoxy.	For such applications as bonding nylon gears to metal shafts or the securing of threaded screws or rods in nylon-and-metal assemblies.
Power Transmission Belting	Page-Lon	A power transmission belting which has elasticity, is lightweight, and can be operated at 10,000 fpm.	Adaptable for paper-mill cone drives, short center drives with high pulley ratios, crossed and quarter turn drives, as well as conventional flat belting drives.

Review of some recently developed materials (continued)

Material	Trade Name	Properties	Applications
Dry Lubricant	Perma-Slik	This graphitized molybdenum-disulphide dry lubricant in a sprayable suspension provides a dry, hard, permanently lubricated surface.	It can be applied to most metals for a variety of applications.
Permanent-Magnet Material	Plastiform 1	A lightweight, rubber-bonded, barium-fer-rite, magnetically oriented, permanent-magnet material that may be cut with ordinary tools.	Used in such applications as magnetic cabinet latches and holding devices.
Heat-Resistant Fiber	Pluton	This all-organic, heat-resistant fiber maintains its flexibility and part of its strength after exposure to intense heat. Free of elemental carbon, it conducts very little heat or electricity and will not char or melt.	When made into a fabric, it may be used as missile motor case liners, insulation in high-speed jet aircraft, and fire-protective curtains.
High-Speed Steel	Rex 49	This steel, which can be heat-treated to 67 to 69 Rockwell C, provides good tool life in machining hard-to-cut metals.	For cutting materials such as highly alloyed steels at high hardness levels, stainless steels, super-alloys, and titanium.
Brazing and Welding Flux	Rexarc Cast-Iron Liquiflux	This product facilitates continuous-brazing operations without the necessity of painting the metal with powdered flux. It enters the flame automatically in a vaporized state with the gas stream and passes through the welding torch into the flame. No special torch is needed.	For brazing steel to cast iron and brass to cast iron; for welding cast iron to cast iron; and hard facing with chromium cobalt tungsten.
Bearing-Retainer Material	Rollube	An alloyed-iron material for roller-bearing retainers operating at temperatures up to 400 degrees F.	Used as standard retainer material for thrust and radial bearings.
Film Adhesive	Scotch-Weld AF-6	This elastomer-phenolic, high-strength, thermosetting, dry-bonding film adhesive provides a uniform adhesive thickness, controlled confinement to a specific area, and simple application procedures.	For structural bonding and honey-comb sandwich construction.
Honing Oil	Shear-Speed Formula 50	This fluid has good solvency and will keep honing stones clean and free-cutting, has a low odor level, and minimizes drying of the skin.	Permits stock-removal rates as high as those with straight kerosene. Can be used with all types of honing and Superfinishing machines.
Electrode	Speedex 710 Mo	A heavy-coated, shielded-arc type of low-alloy steel electrode which can be used in all positions with direct current, reverse polarity.	Applications include use on high-pressure piping in power plants and refineries, and machine and structural fabrication.
Chromium-Nickel Alloy	Supertherm	This alloy, operating in a temperature range of 1800 to 2300 degrees F., contains 26 per cent chromium and 35 per cent nickel, as well as some cobalt and tungsten.	Used as a furnace-hearth grid assembly to support rocket-engine parts during a brazing cycle of five to eight hours.
Temperature Indicators	Thermocron Crayons and Detecto Temp Paints	These easy-to-use devices accurately indicate the temperature of any hot surface by distinct changes in color.	These eighteen crayons and thirty-six paints cover a temperature range of 104 to 2462 degrees F.

Review of some recently developed materials (continued)

Material	Trade Name	Properties	Applications
Titanium Alloy	Ti-8Al-1Mo-1V	This creep-resistant titanium alloy has a density of 0.156 pound per cubic inch and can be forged using the same practices and tooling as other titanium alloys.	For use as jet-engine components such as compressor discs, spacers, and blades at service temperatures up to 900 degrees F.
Fluxless Solder	Tin-A-Lum	A fluxless solder which melts at a low temperature, and is said to have a tensile strength comparable to some welded and brazed joints.	For use on aluminum and its alloys, zinc, tin, pewter, magnesium, and other metals.
Nitriding Process	Tufftride	A liquid nitriding process for developing a tough, ductile, wear-resistant surface and increasing the fatigue strength of various steels and cast irons.	Makes possible the substitution of lower-cost materials in such applications as ball joints, gears, thrust washers, steering components, and crankshafts.
Tool Steel	UHB Calmax	An air- or oil-hardening chromium-tungsten-cobalt steel that has an extremely high hot-hardness combined with a great toughness at high temperatures.	Recommended for hot-pressing dies, mandrels, extrusion dies, and die-casting dies for copper, brass, and similar alloys.
Shim Stock	Ultra-Micro	This ferrous and nonferrous strip and shim stock with 0.0001-inch tolerances is available in brass, steel, aluminum, titanium, stainless steel, and other metals.	Available in thicknesses from 0.0005 to 0.125 inch, in widths up to 6 inches, it is used for precision parts and controls.
Stainless Steel	Uniloy 303MA	This chromium-nickel stainless steel, to which the proper combinations of sulphur and aluminum additions have been made to provide free-machining properties, is available in popular bar sizes in rounds, squares, and hexagons.	Useful for making various fittings, fasteners, and other parts.
High-Strength Steel	Unimach UCX2	This steel, which is readily formable and weldable, exhibits yield-strength levels of 225,000 to 235,000 psi.	Developed specifically for high-performance rocket-motor cases for the aerospace industry.
Antivibrational Material	Vibra-Check	This synthetic material is composed of two layers of vinyl-chloride elastomeric resin bonded to both sides of a strong reinforcing core of monofilament fiberglass.	May be used on slippery floors, such as vinyl and asbestos tile, on which it will not creep.
Iron-Base Alloy	W-545	This austenitic iron-base alloy contains nickel, chromium, and relatively small proportions of molybdenum, titanium, boron, silicon, and manganese.	It was developed primarily to meet the need for a material for gas-turbine discs.
Superalloy	WaiMet Improved WI-52 Superalloy	A cobalt-base, high-tungsten superalloy that possesses high-temperature strength in the 1850-degree F. range, with good ductility and corrosion resistance.	Has good castability and foundry characteristics. Used for investment casting aircraft gas-turbine parts, such as vanes and blades.
Die-Casting Alloy	Zamak-7	This zinc die-casting alloy has a low casting temperature, which means a long die life with a minimum of maintenance and little fouling of dies.	Its use facilitates production of zinc die castings with good surface finish and thin wall sections.

Review of some recently developed materials (continued)

Names and Addresses of Manufacturers of Products Listed

- ACI Type CD-4MCu—Alloy Casting Institute, 101 Franklin Ave., Garden City, N. Y.
- Airco Welding Wires—Air Reduction Sales Co., a division of Air Reduction Co., Inc., 150 E. 42nd St., New York 17, N. Y.
- Allaco Foundcast 101, Sandbind 201, Facecoat 301, and Multicast 401—Allaco Products, 238 Main St., Cambridge 42, Mass.
- Allegheny Ludlum Composite Tubing—Allegheny Ludlum Steel Corp., Oliver Bldg., Pittsburgh 22, Pa.
- Allied All-Metal Honeycomb—Allied Research & Engineering Division, 6916 Santa Monica Blvd., Los Angeles 38, Calif.
- All-State Bright Finish No. 23—All-State Welding Alloys Co., Inc., 249-55 Ferris Ave., White Plains, N. Y.
- Alphatizing—Alloy Surfaces Co., Wilmington, Del.
- Alstan—National-Standard Co., Niles, Mich.
- Anchorlube—Anchor Chemical Co., 10719 Briggs Road, Cleveland 11, Ohio
- Armco High-Strength No. 6 and No. 7—Armco Steel Corp., Middletown, Ohio
- Beryllium Fasteners—Standard Pressed Steel Co., Jenkintown, Pa.
- B/G No. 505—Baker/Gubbins Co., 1448 Wabash Ave., Detroit 16, Mich.
- B/G No. 576—Baker/Gubbins Co., 1448 Wabash Ave., Detroit 16, Mich.
- CA-704, CA-711, and CA-720—Allegheny Ludlum Steel Corp., Carmet Division, Oliver Bldg., Pittsburgh 22, Pa.
- Carpenter Vega (AISI Type A-6)—Carpenter Steel Co., Reading, Pa.
- Chemlok 220 and 203—Hughson Chemical Co., Erie, Pa.
- Clo-Flex 621—Harrington Paint Co., Inc., 1641 Collamer Ave., East Cleveland 10, Ohio
- Cohrlastic—Connecticut Hard Rubber Co., 407 East St., New Haven 9, Conn.
- Corcast and Cortamp—Corning Glass Works, Corning, N. Y.
- Cuposit LT-26—Shipley Co., Inc., Walnut St., Wellesley 81, Mass.
- Dargraph—Darwin & Milner, Inc., 2222 Lakeside Ave., Cleveland 14, Ohio
- Durethane Polyethylene Film—Plastics Division, Koppers Co., Koppers Bldg., Pittsburgh 19, Pa.
- Elastine—Shurclose Seal Co., 17411 E. Warren Ave., Detroit 24, Mich.
- Enstrip NP—Enthone, Inc., 442 Elm St., New Haven 8, Conn.
- Epoxy-Patch No. 0151—Hysol Corp., 322 Houghton Ave., Olean, N. Y.
- e.t.d. 150—La Salle Steel Co., P. O. Box 6800-A, Chicago 80, Ill.
- Fiberfrax—Carborundum Company, Refractories Division, Perth Amboy, N. J.
- Flamescent—Duro-Test Corp., North Bergen, N. J.
- Flexaust GlasHose—Flexaust Co., 100 Park Ave., New York 17, N. Y.
- Flex-O-Boys—Associated Plastics Inc., Cleveland, Ohio
- Gentrode 10—General Electric Co., Schenectady 5, N. Y.
- Hardtem—Heppenstall Co., 4620 Hatfield St., Pittsburgh 1, Pa.
- Heat-Rem H-120A—Speco Inc., 7308 Associate Ave., Cleveland 9, Ohio
- Heat-Rem H-170 Super—Speco Inc., 7380 Associate Ave., Cleveland 9, Ohio
- Honite One - Twenty - Six—Minnesota Mining & Mfg. Co., 900 Bush Ave., St. Paul 6, Minn.
- Hydro-T Metal—Whitehead Metals, Inc., 303 W. 10th St., New York 14, N. Y.
- Impel Casting—Titanium Metals Corp. of America, 233 Broadway, New York 7, N. Y.
- J&L DOM Electricweld—Electricweld Division, Jones & Laughlin Steel Corp., 3 Gateway Center, Pittsburgh 30, Pa.
- Kenspray—Kennametal Inc., Latrobe, Pa.
- Kinetic Isolation Pads—Consolidated Kinetics Corp., 1065 Dublin Road, Columbus, Ohio
- Korfund Vibrodamper—Korfund Co., Inc., 48-39M 32 Place, Long Island City 1, N. Y.
- Lesco BG 41 Vac Arc—Latrobe Steel Co., 2626 Ligonier St., Latrobe, Pa.
- Lesco BG 41, 42, and 43—Latrobe Steel Co., Latrobe, Pa.
- LTV 602—Silicone Products Dept., General Electric Co., Waterford, N. Y.
- Lukens Plastic - Clad Steel—Lukens Steel Co., Coatesville, Pa.
- Magnesium Phototemplate and Layout Sheet—Dow Metal Products Co., Midland, Mich.
- Mar-aged Steel—International Nickel Co., Inc., 67 Wall St., New York 5, N. Y.
- Maskant S51K808—Rinshed-Mason Co., Detroit 10, Mich.
- Metex Antitarnish M-667—MacDermid Inc., Waterbury 20, Conn.
- Metex Nickel Stripper BR—MacDermid Inc., Waterbury 20, Conn.
- Micro - Chip—Kaiser Aluminum & Chemical Corp., Kaiser Center, 300 Lakeside Drive, Oakland 12, Calif.
- Milford Flat Stock—Henry G. Thompson & Son Co., New Haven 5, Conn.
- Mobilmet Cutting Fluids—Mobil Oil Co., division of Socony Mobil Oil Co., Inc., 150 E. 42nd St., New York 17, N. Y.
- Molybube Open Gear, Gear-Kote, and B-R Geartext Compounds—Bel-Ray Co., Inc., Farmingdale, N. J.

Review of some recently developed materials (continued)

Names and Addresses of Manufacturers of Products Listed

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| N2E—Udylite Corp., Detroit 11, Mich. | Orbit—Crucible Steel Company of America, 4 Gateway Center, Pittsburgh 22, Pa. | Supertherm—Electro-Alloys Division, American Brake Shoe Co., Elyria, Ohio |
| Neu-Tec-Tronic 157BN—Eutectic Welding Alloys Corp., 40-40 172nd St., Flushing 58, N. Y. | PA-749 and PA-708—Plastic Associates, 2900 South Coast Blvd., Laguna Beach, Calif. | Thermocron Crayons and DetectoTemp Paints—Air Reduction Sales Co., a division of Air Reduction Co., Inc., 150 E. 42nd St., New York 17, N. Y. |
| NewBide N-20, N-50, N-60, N-70, and N-80—Newcomer Products, Inc., Latrobe, Pa. | Page-Lon—Page Belting Co., Concord, N. H. | Ti-8A1-1Mo-1V—Titanium Metals Corp. of America, 233 Broadway, New York 7, N. Y. |
| Nitrobraz S Series—Wall Colmonoy Corp., 19345 John R. St., Detroit 3, Mich. | Perma-Slik—Everlube Corp., 6940 Farmdale Ave., North Hollywood, Calif. | Tin-A-Lum—Metals for Industry, Inc., 299 Pavonia Ave., Jersey City, N. J. |
| No. 14M Magnaglo, No. 9BM Magnaflux, and No. 1 Gray Powder—Magnaflux Corp., 7300 W. Lawrence Ave., Chicago 31, Ill. | Plastiform 1—Leyman Corp., 5178 Crookshank Road, Cincinnati 38 Ohio | Tuffride—Kolene Corp., Detroit 23, Mich. |
| NS-A286—National-Standard Co., Niles, Mich. | Pluton—Minnesota Mining & Mfg. Co., 900 Bush Ave., St. Paul 6, Minn. | UHB Calmax—Uddeholm Co. of America, Inc., 155 E. 44th St., New York 17, N. Y. |
| Nylatron GS—Polymer Corp., 2120 Fairmont Ave., Northmont, Reading, Pa. | Rex 49—Crucible Steel Company of America, Pittsburgh 22, Pa. | Ultra-Micro—Industrial Division, American Silver Co., Inc., 36-04 Prince St., Flushing 54, N. Y. |
| Nymet—Climax Metal Products Co., Cleveland, Ohio | Rexarc Cast-Iron Liquiflux—Rexarc, Inc., West Alexandria, Ohio | Uniloy 303MA—Universal-Cyclops Steel Corp., Bridgeville, Pa. |
| Oakite FM 182—Oakite Products, Inc., 126 Rector St., New York 6, N. Y. | Rollube—Rollway Bearing Co., Inc., 541 Seymour St., Syracuse 4, N. Y. | Unimach UCX2—Universal-Cyclops Steel Corp., Bridgeville, Pa. |
| Oakite FM 286—Oakite Products, Inc., 126 Rector St., New York 6, N. Y. | Scotch-Weld AF-6—Adhesives, Coatings & Sealers Division, Minnesota Mining & Mfg. Co., 900 Bush Ave., St. Paul 6, Minn. | Vibra-Check—Lowell Industries, Inc., Allston Station, Boston 34, Mass. |
| Oakite HD 126—Oakite Products, Inc., 126 Rector St., New York 6, N. Y. | Shear-Speed Formula 50—Shear-Speed Chemical Products Division, Michigan Tool Co., 7125 E. McNichols Road, Detroit 12, Mich. | W-545—Westinghouse Electric Corp., Materials Mfg. Dept., Blairsville, Pa. |
| Oakite Stripper 150—Oakite Products, Inc., 126 Rector St., New York 6, N. Y. | Speedex 710 Mo—Metal & Thermit Corp., Rahway, N. J. | WaiMet Improved WI-52 Superalloy—WaiMet Alloys Co., 5320 Oakland Blvd., Dearborn 2, Mich. |
| Oilite (IM)—Amplex Division, Chrysler Corp., Detroit 31, Mich. | | Zamak-7—New Jersey Zinc Co., 160 Front St., New York City |

Research Started on Grading of Grinding Wheels

The Grinding Wheel Institute has contracted with the University of Michigan to have extensive research conducted on the development of a method of grading grinding wheels. It is the hope of the Institute that the ultimate results of this research work will be the establishment of a

standard method of grading. With such a standard method available, it will then be possible for the industry to establish standards for grades of grinding wheels which would be the same regardless of the source of manufacture. Initial work along this line shows much promise.

DON'T *let the drill chips fall where they may!*

W. A. RUNION, Methods Engineer
National Automatic Tool Co., Inc.
Richmond, Ind.

WHEN ASKED what one problem causes most consternation to both machine tool builders and machine tool users, the most frequent answer is: chips. Chips are the most undesirable desirable: You cannot produce a hole with a two-flute twist drill without producing chips, and as soon as you have produced chips, they become a headache. They pile up in front of locators, jam rest locator buttons, and clog working parts. An old attitude toward chips was, "Let them fall where

they may." But as machines have become more complicated, larger, longer, and involved in more automatic operations, complacency has turned to concern. Thoughtful action is in order.

Early machine tool users attempted to get rid of chips by using auger type conveyors, such as those employed in farm elevator equipment. But, along with everything else, this method was improved, in progressive steps, through shaker type conveyor systems to the presently popular drag-

Fig. 1. Drag-link conveyor (lower left) is favorite method of removing chips from large transfer-machine bases.



link chip conveyor, Figs. 1 and 8. The latter are well suited to the long flights in pits under big straight-line transfer machines.

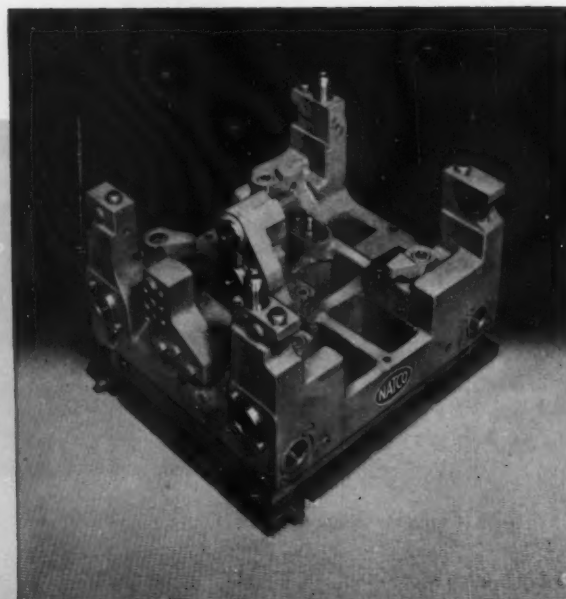
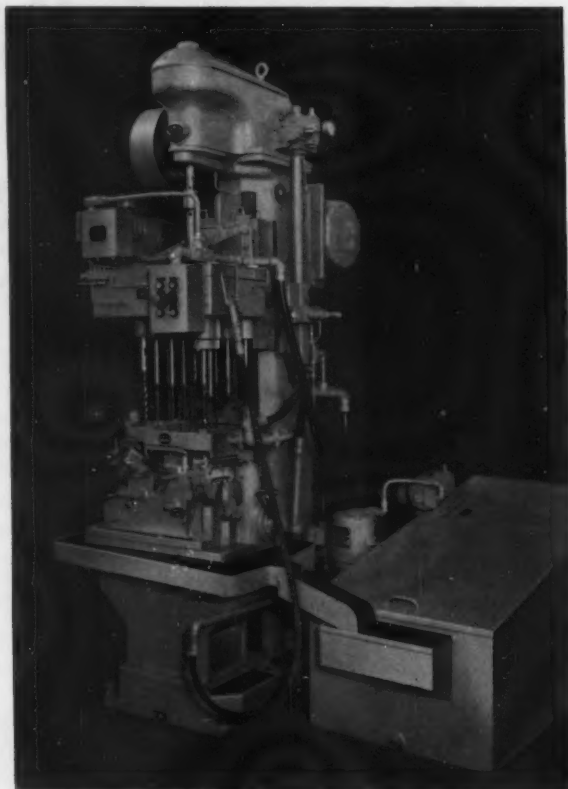
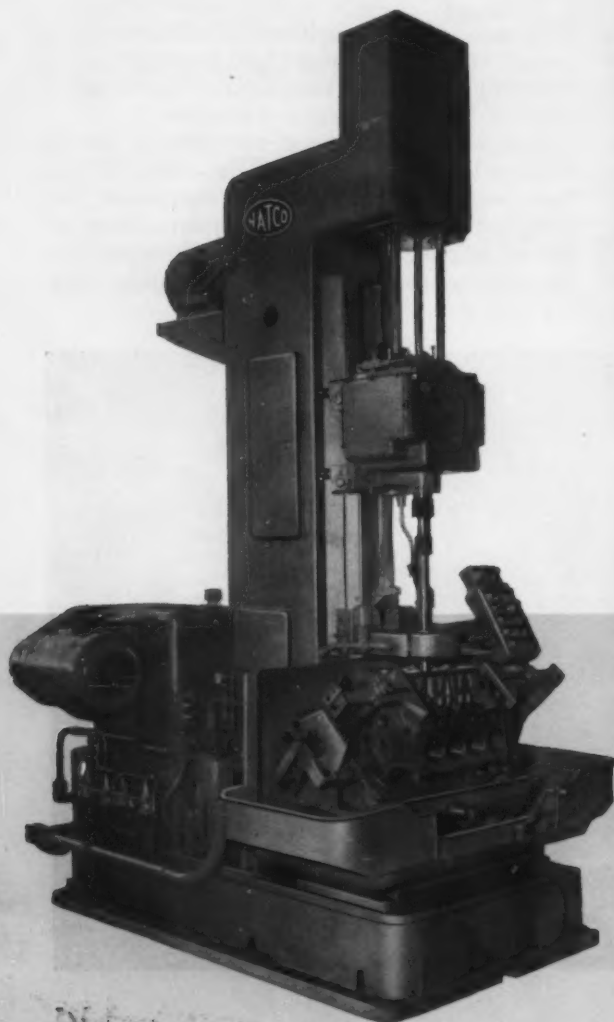
But the disposal of the chips themselves is only one of the problems involved. For simplification, assume that the chips obediently go where they should go. Equally important is the matter of keeping the chips away from places where they should not go.

If coolant is used, consideration must be given to filtering entrained chip particles, Fig. 2. Filtering systems range from the very simplest, a series of baffles in a settling tank, through flotation, magnetic drums and disposable vapor processes to combinations of the foregoing. The reason for filtering, in most cases, is to remove tiny particles. They must not circulate to damage the coolant systems and supply lines, or injure the product.

So long as drills turn, chips will be produced. They seem to like getting into places they should not enter. A favorite spot chips seem to seek out

Fig. 2. (Below) Filtering system for individual machine has an elevator to transfer a high volume of chips to a container or central chip-disposal conveyor.

Fig. 3. (Bottom, left) Pallet fixture has sloped shed-roof base for disposing of chips.



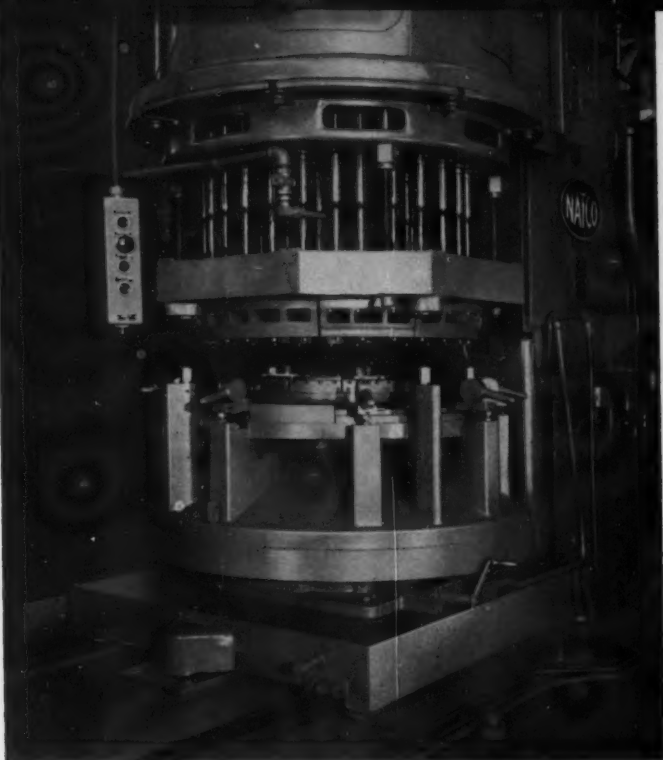


Fig. 5 (Left) Rotary fixture on sliding table directs chips down shed-roofed sides in all directions.

is where shafts move in bearings, either rotating or axial. Disappearing locating pins also seem to attract chips. One machine tool builder has made it standard practice to place a piston-ring around moving plungers and pins to exclude chips that might cause plungers to stick.

Different types of fixtures require various individual methods for solving the problem of chip dirt. In stationary fixtures, the device is often roofed with a shed having an angle greater than the angle of repose of the chips, Fig. 3. Another favorite solution for stationary fixtures is to replace the usual solid fixture base with one composed of a series of strips or ribs, Fig. 4. This con-

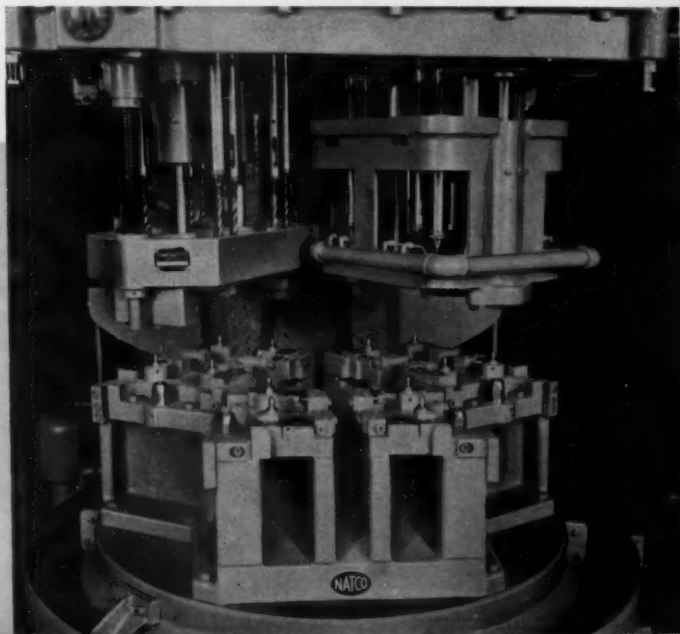
Fig. 4. (Left) Open grid base lets chips fall through this pallet fixture.

struction allows the chips to fall into the base pan of the machine, where they can easily be removed for disposal or salvage.

Sliding fixtures also have their share of problems with chips. Here again, shed roofing is the most favored solution, Fig. 5. Rotating table type fixtures often have a shed roof, since the index impact of the table aids in removing chips. The shed-roof angle can be lessened somewhat through the use of a chip trough and paddles about the table, Fig. 6.

Of the various common styles of fixtures, the trunion design appears to be less affected by chips than any other. This is because all parts are

Fig. 6. (Right) Rotating fixture on rotary table has sloped chip sheds. Paddles in the chip trough push chips along conveyor to filter.



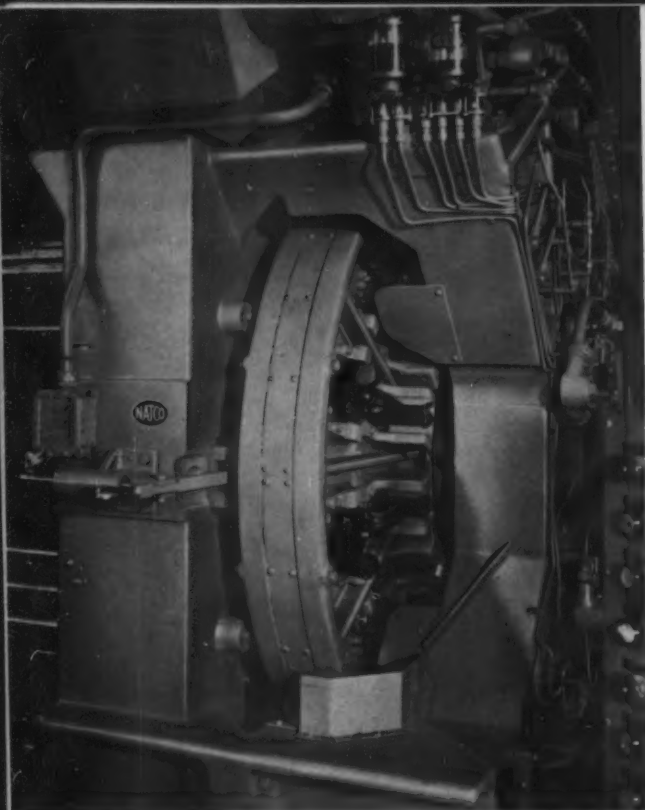
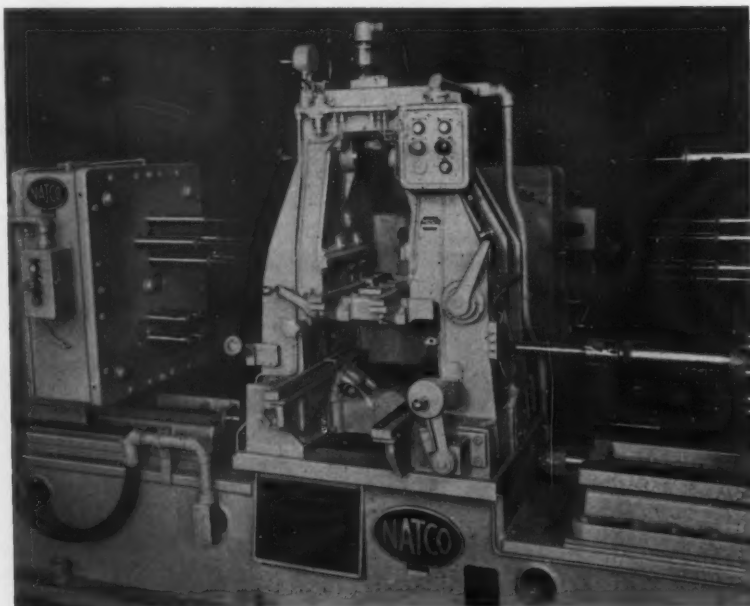


Fig. 7. Trunion fixture is ideal for chip disposal. Parts rotate through 180 degrees so that chips fall out into machine base.

turned upside down, allowing the chips to fall off during the indexing cycle, Fig. 7. The best time to "whip" the chip problem is when the fixture is designed. Machines ought to be checked for excessive use of flat surfaces where chips can accumulate. When a machine is being designed, it is well to adopt the attitude that no part of the machine or fixture is safe from damaging chips.

Although chip-handling facilities should be basic in machine design, there is no scarcity of examples in which designers have forgotten this fundamental corollary to metal-cutting. The extent to which the designer anticipates the chip-disposal problem, and thereby saves headaches and money later, should be an important factor in decisions on new machine tool purchases.

Fig. 8. Drilling units should have chip-disposal facilities built into them for easy chip removal. This transfer-machine building block has a trough in the base, as seen in this end view, left of name plate.



MACHINERY'S

Reference Section

For the Designer:

How to Delineate Screw Threads

Part I. Identifying and Specifying

ROBERT V. Mac KENZIE
Development Engineer
Cone Automatic Machine Co.
Windsor, Vt.

OCTOBER 1961

How to Delineate Screw Threads

Part I. Identifying and Specifying

ROBERT V. Mac KENZIE
Development Engineer
Cone Automatic Machine Co.
Windsor, Vt.

THE BLUEPRINT is the machinist's guide to his destination. The goal is the completed part, finished within the required tolerances. Whether or not the machinist ever reaches this goal depends to a large extent upon the accuracy and adequacy of the blueprint or detail drawing.

Many things contribute to making a drawing adequate from the standpoint of the machinist. Besides a lucid graphical representation of the part, and clear dimensioning of all the critical features, there should be explanatory notes wherever necessary. The presentation should be simple, concise, clear, and complete enough so that the part can be manufactured without reference to any other source.

This matter of completeness is very important. Unless the detail drawing supplies all of the pertinent information, pictorial as well as textual, it has failed in its objective. For if the machine operator, or the inspector, has to interrupt the normal production of a part to clarify a point, or to resort to other sources for data, the drawing is incomplete. In this event, production time and costs are increased above those which were anticipated. It is a very frequent reason for manufacturing costs to exceed estimated costs in the initial production stages of an item. About the only exception to this need for completeness would be in the case of an experimental or prototype part, where periodic consultation with an engineering group is often required or desired during processing.

Threads appear so often in design specifications that a clear conception of the accepted methods of representation is necessary. Standardization of threads has been a slow process. This and the multiplicity of seemingly endless variations have retarded the formulation of a broadly established drafting procedure. But the proverbial "ounce of prevention" applies quite emphatically to threading, and there is no better

place to forestall trouble than at the drawing-board. After the designer has weighed the requirements, made his calculations, and chosen the thread, the next step is to define the specification and transfer it to the drawing.

The language of threads is comprehensive and coherent, and advantage should be taken of this at every opportunity. But the language of threads is also complex and often subject to misinterpretation. For this reason it is important that the thread is correctly and completely specified and described so that the shop can interpret the requirement and produce the finished part from the drawing. Standard and accepted symbols and terminology should be adhered to. The art has progressed beyond the point where designations such as

20 T.P.I. or 1/2-13 THREAD

will suffice. When there is a choice, the specifications least likely to be misunderstood should be used. There are situations where quite different threads can be produced from two sets of specifications which are intended to be synonymous. This should be avoided.

Needless to say, there will be times when some degree of discretion will have to be used in putting information on the drawing. What is essential and what is superfluous will have to be decided. The method of producing the thread will have some bearing on this. For example, when a hole is to be tapped with a standard solid tap, practically all of the thread elements are manufactured into the tap. Therefore, the machine operator has no control over them, and usually they do not need to appear on the drawing.

When a collapsible tap is used, or the thread is external and is to be cut with a chasing tool, a die-head, or a milling cutter, there are thread features which the operator can control. More information will then be required. If the thread

A clear and complete representation of all the pertinent features of screw threads by the designer will do much to eliminate costly misinterpretation of production drawings in the shop. Here is the first of a two-part, comprehensive review of what a designer should know in order to adequately delineate screw threads. The information presented is fundamental and practical, and covers the many types of threads in use today. This series is based on a chapter of the author's new book entitled *Screw Threads*

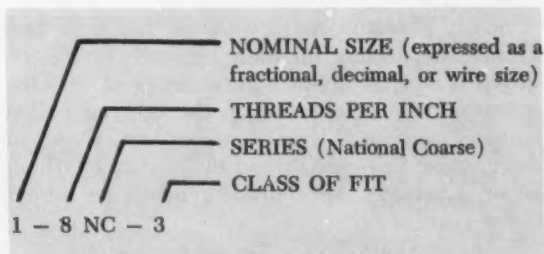
—Design, Selection and Specification*

happens to be on a precision lead-screw and is to be ground, the extreme is reached where the operator has a direct control over most of the critical factors, including flank angle, lead, pitch diameter, minor diameter, and taper. In such cases, it becomes mandatory to specify and provide tolerances for all of these elements on the drawing.

The first task is to decide upon the thread description. This information falls into two basic groups, i.e., identification and specification. How well these two steps are correlated determines the ease in interpreting the drawing.

Thread Identification

Proper identification of the thread should be a preliminary step, and should precede the actual drawing of the thread on the part. The identity is conveyed by symbols, four of which should always appear on the drawing, thus:



Nominal Size. This is the major diameter of the screw or nut. Generally it is given as the nominal fractional size or as the wire size. Dimensions are implied to be in inches, so the symbol for inches is omitted. Where the nominal size is a wire size

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its decimal equivalent should show in parentheses:

Example: #5 (.125)-40 NC

or, better still, as part of the specifications.

In addition to the nominal size, the maximum major diameter is quite often given decimally. There are some classes of fit and some thread series where the nominal size is not the same as the maximum major diameter, and in these instances it becomes necessary to qualify the identification by specifying the exact diameters for the given class. This condition exists in Class 1 external threads of the American National Series and in Classes 1A and 2A external threads of the Unified Series.

Example:

1-8 NC-1 External
Maximum Major Diameter .9966
1/4-28 UNF-2A
Maximum Major Diameter .249

Threads Per Inch (Pitch). While the term "pitch" is quite commonly used for threads per inch, it is incorrect! Pitch is the distance between corresponding points on adjacent threads. Thus, a screw with 8 threads to the inch has a pitch of 0.125 inch. A screw with 64 threads to the inch has a pitch of 0.01563 inch. The number of threads per inch or the pitch should always be indicated regardless of whether it is the standard for the particular size or is special.

Series. This identifies the thread as to form or configuration. For example, the symbol NC means National Coarse and designates a thread form satisfying all of the established requirements for this series.

Class of Fit. Because of its nature, this last identifying symbol is more aptly a designation of specification. Once the class of fit is denoted, most of the specifications for the thread are auto-

MACHINERY'S REFERENCE SECTION

matically established. It makes their incorporation on the drawing more or less a convenience for the shop, except in special circumstances. These specifications include the major, minor, and pitch diameters, together with their respective tolerances and allowances.

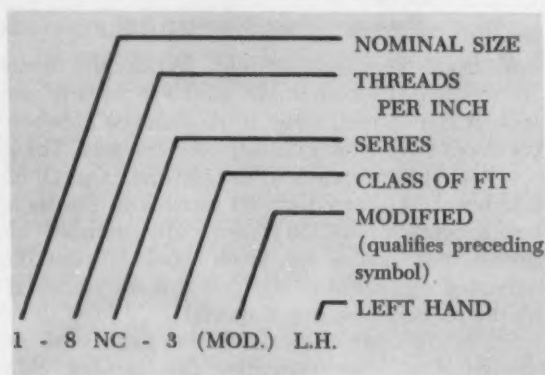
Example:

	1-8 NC-3 (External)		
	Maximum	Minimum	Tolerance
Major Diameter	1.000	.9848	.0152
Pitch Diameter	.9188	.9134	.0054
Minor Diameter	.8466	.8322	.0144

Thread Specification

When the thread is a standard one, all the essential information is implied in the identifying symbols. In many cases this is all that appears on the drawing. But when this happens, the machinist is forced to find the various elements of the thread in a handbook or similar reference. Besides being inconvenient, this practice induces possible misinterpretation and increases the chances of error. The symbolical thread definition makes for a simpler drawing, but in the interest of accuracy, it is desirable to have all the pertinent specifications appear on the drawing. This is especially true whenever the thread deviates from standard, or when any particular dimensions fall within the control of the machinist.

Thus, by adding to the basic identifying symbols the information which they imply, as well as any other applicable instructions, production is facilitated and accuracy is encouraged.



Major Diameter	.998/.984
Pitch Diameter	.9188/.9134
Minor Diameter	.8466/.8322

In this example the exact dimensional limits of the different diameters have been given. Reference to other sources of information is unneces-

sary. The major diameter deviates from the standard for Class 3, the maximum being 0.002 inch below basic value. Whenever there is a variation of some standard feature—as, in this case, the major diameter—the thread is symbolized in the usual manner but the letters MOD., signifying “modify,” are suffixed to the symbol involved. It is also explained below the designation as illustrated.

Because they are predominantly so, threads are always considered to be right-hand, unless specified differently. The symbol is R.H. but for the sake of simplicity is never shown. The symbol L.H. designates a left-hand thread and, where called for, should always appear on the drawing, immediately following the class of fit.

Special Features

In addition to the basic symbols and the qualifying designation MOD., there are special symbols for certain threads, and other supplementary instructions which should be added to the thread designation or specification whenever necessary.

Unified Threads. Because the diameters for the screw are not the same as those for the nut, Unified threads are identified by a symbol to indicate whether they are for the screw or the nut. This symbol follows the class of fit. “A” indicates an external thread and “B” an internal.

Thus

3/4-16 UNF-2A

designates a Class 2 screw and

3/4-16 UNF-2B

indicates a Class 2 nut.

Acme Threads. Acme threads fall into two groups, depending on their ultimate use. Each group is further divided into classes of fit. One group is called Centralizing; the other is called General Purpose. It thus becomes necessary when designating an Acme thread to indicate to which group it belongs. Appropriate symbols are added to the class of fit.

5/8-8 ACME-2G is a General Purpose (G) Class 2 Acme thread 5/8 inch in major diameter, 8 threads to the inch.
5/8-8 ACME-3C represents a Centralizing (C) Class 3 Acme thread of the same nominal size and pitch.

Stub Acme. In addition to the standard Stub Acme series there are two recognized alternate forms. These are designated M1 and M2, and

THE DESIGNATION SHOWN DENOTES
SCREW IS DESIGNED TO PUSH

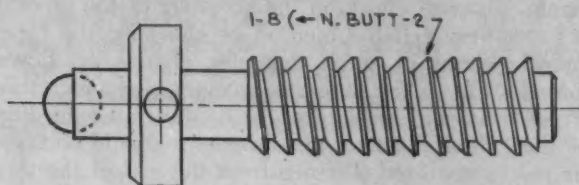


Fig. 1. The designation of a buttress thread should indicate which flank is to be the leading flank. Here, the pressure flank is the leading flank.

this symbol is inserted directly after the word "ACME."

5/8-8 STUB ACME M2

This is a Stub Acme modified to Form 2.

Buttress. The unsymmetrical buttress thread usually employed for thrust purposes can be designed to push or to pull. Hence it becomes necessary to clearly indicate which is the leading flank (Fig. 1). The leading flank is the one which faces the mating part in order to engage. When the screw is designed to push, the pressure flank is the leading flank. If it is designed to pull, the trailing flank will be the leading flank. The leading flank is the same for screw and nut. The following symbol identifies the leading flank.

(← The screw pushes. The pressure flank is the leading flank.

←(The screw pulls. The trailing flank is the leading flank.

A buttress thread 1 inch in diameter, 8 threads to the inch, Class 2, left-hand, where the screw is to push is designated:

1-8 (← N.BUTT-2 L.H.

If the screw were designed to pull, the designation would be

1-8 ←(N.BUTT-2 L.H.

Pipe Threads. This is a rather large group of threads of different series which are all classed together under the general term "pipe threads." Some are straight and some are tapered. With one or two exceptions, they are used as fastening threads in pipe connections. Often they have the added function of serving as a seal.

Because each series is well defined, and there are wide differences between them, care and consideration should be used in the selection and designation of pipe threads.

There is another important reason for this care. Unlike most other threads, the nominal size designation of a pipe thread, except for large

sizes, does not indicate the major diameter. Nominal thread size generally indicates the size of the hole running through the length of the pipe. The major diameter is based on the outside diameter of the pipe and is therefore determined by the specific wall thickness required for the hole or bore size. This practice was established years ago and holds true for all pipe except the larger sizes. On sizes having a 14-inch outside diameter or larger, the nominal size is the outside or major diameter.

The major diameter varies considerably for the different pipe series. On tapered threads it becomes pretty much academic. In other cases, major diameter limits are fixed by different considerations. As shown in Table 1, threads having the same nominal size can have widely differing major diameters. Thus it becomes important not only to designate the thread correctly, but to give the actual major diameter as well.

An important part of the pipe-thread specification is the length of thread. This is especially true

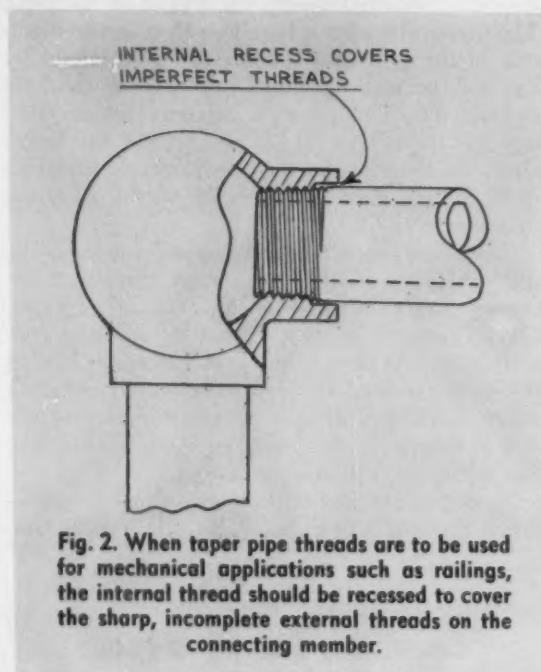
Table 1. Basic Dimensions of Various
1-11 1/2 Pipe Threads

Nominal Size	Major Diameter	Pitch Diameter
1 - 11 1/2 NPT	1.315	1.2136*
1 - 11 1/2 NPTR	1.315	1.2299*
1 - 11 1/2 NPSM	1.2965	1.2386 1.2305
1 - 11 1/2 NPSL	1.3183 (calculated)	1.2523 1.2604
1 - 11 1/2 NPSH	1.3051←Internal→ 1.2951←External→	1.2486 1.2386

*At Start of External Thread.

of the taper pipe threads where the thread length is tied in with the pitch diameter and assumes an equal importance in determining the acceptability of the thread. In fact, the gaging system for taper pipe threads is based upon this interrelation of pitch diameter and thread length.

On railing joints, which are strictly mechanical in nature but which use the taper pipe thread (NPTR), the length of thread is very important. This thread series utilizes the large end of the taper pipe thread and the over-all length is reduced by from 3 to 4 threads. A shallow recess or counterbore precedes the threads of the internal member and covers the imperfect threads on the male component (Fig. 2), eliminating any danger from sharp threads left exposed.



The straight pipe threads have specific length requirements predicated on their end use. For example, hose couplings (NH and NPSH) require a short thread for quick and easy assembly. Yet the thread must be long enough to help counteract the looseness created by the allowances permitted in pitch diameters.

Taper Threads. Taper pipe threads with the standard $1^\circ 47' 24''$ taper (1/16 inch per inch) constitute the bulk of taper threads. There is little need to specify the taper. It is implied in the designation.

In those instances where the thread has some special taper, it is very important that the amount of taper appear on the drawing. It is recom-

mended that the taper be denoted in degrees from the thread axis. Also, the pitch diameter at two or more points should be given. In this way a measurement of the pitch diameter will be a cross check on the accuracy of the taper. One very reliable method of checking the taper in terms of pitch diameter change is shown in Fig. 3. The suggested manner of showing threads having special tapers is illustrated in Fig. 4. Pitch diameter measurements should be taken at some fixed distance from the end of the thread.

American National Gas Outlet. This rather large series is identified by the symbol NGO. The designation for these threads must always indicate whether the thread is right- or left-handed and whether internal or external. The full designation is intended to prevent cross connecting of valves and the possible admixture of noncompatible gases. As an example, the designation

.903-14 NGO-RH-EXT.

represents a right-hand external thread of National Gas Outlet Form having 14 threads to the inch and a 0.903-inch major diameter. The designation INT. is used to denote an internal thread.

As an additional safeguard against connecting the wrong lines or valves, the different thread sizes in the NGO series are assigned only to single gases, or groups of gases whose admixture would create no hazard. The separation of these sizes by "external" and "internal," "right hand" and "left hand," and different actual diameters provides for wide variety.

The actual sizes are separated by a sufficient difference in diameter to prevent cross connecting. For this reason, the nominal size is usually a decimal, and is the actual major diameter, as in the preceding example. All NGO threads are 14 pitch.

Unified Miniature. With the trend toward smallness, especially in the electronic and instrumentation fields, standardization of miniature threads has become mandatory. This series is designated by metric size. The symbol UNM is used to denote Unified Miniature and is preceded by the metric basic major diameter, which becomes the nominal size. As an example:

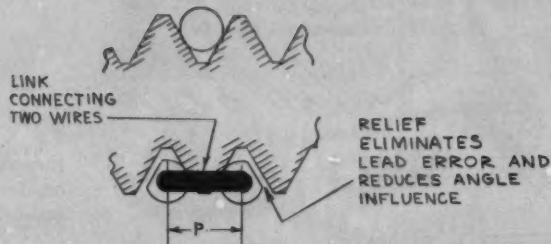
90 UNM

This is a Unified Miniature Form, 0.90 mm in diameter and with 0.225-mm pitch (113 threads to the inch).

While the above designation is sufficient because the diameter and pitch combinations have been established, a more preferable designation for American use would be:

90 UNM (.0354"-113)

Fig. 3. The taper of pipe threads can be accurately checked by measuring the pitch diameters by this improved three-wire method at two or more points. Two of the wires are linked and relieved as shown to eliminate lead and angle errors.



which gives the inch equivalent (0.0354) of the nominal size (0.90 mm) and the number of threads per inch (113).

The latter designation should be used because it fulfills the requirement of having all the information on the drawing. It is also recommended that the specifications be included on all drawings and that these indicate the required values and tolerances for the major diameter, pitch diameter, and minor diameter.

Multiple Threads. Special attention should be given to the manner in which multiple threads are specified. These threads are the ones most often incorrectly identified. Because the lead is always some multiple of the linear pitch, it will forestall confusion to clearly denote both of these on the drawing. Use of the terms "double," "triple," etc., should be avoided. If used at all, these terms should be in the specification and not in the designation. In their stead, the pitch and the lead in decimals are both made part of the designation, as, for example:

2-0.125p-0.250L-ACME 5C-LH

calls for a 2-inch diameter, 8-threads-per-inch, double-lead, Acme Form, Class 5 Centralizing left-hand thread; and

.625-0.0625p-0.500L-NS

calls for a 5/8-inch diameter, 16-threads-per-inch,

8-start (Octuple lead), National Form, Special right-hand thread.

These two examples show that the description can be quite complicated. The designation properly given can adequately impart all the information in the description. For clarity and emphasis, however, both the description and the designation should appear on the drawing.

Coated Threads. Threads which are to be plated or otherwise superficially coated after machining are symbolically identified in the usual manner. The specification should include the pitch diameters before and after plating. This is the best way to be certain that interchangeability will prevail after the screws are coated.

Example:

1/2-13 UNC-2A

Major Diameter	0.493/.487 (before plating)
	0.500 MAX (after plating)
Pitch Diameter	.448/.444 (before plating)
Pitch Diameter	.450/MAX (after plating)

In some cases, only the "after plating" pitch diameter will be necessary. This may be true where the class of fit allows considerable latitude. Wherever the threads are a close fit, the inclusion of the "before plating" pitch diameter in the specifications will avoid a situation where the ma-

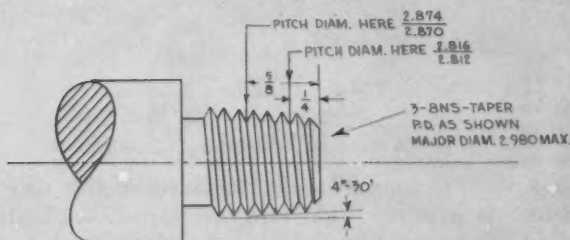


Fig. 4. Method suggested for designating threads having special tapers. Pitch diameter measurements are given at fixed distances from the end of the thread.

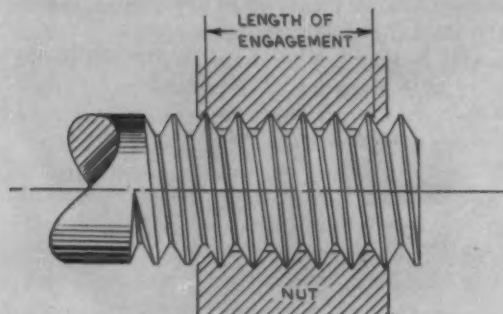


Fig. 5. Where necessary (as in the case of translating threads) the length of engagement should be indicated on drawings. The term refers to the actual maximum amount of thread contact possible and not to the length of the thread.

chine operator has to decide how much of a plating allowance to provide for.

Length of Engagement. This is a very important consideration. Where applicable, this length should appear either as a general note or, better yet, as a distinct part of the specifications. It should appear on the detail drawing of the screw as well as that of the mating part. Length of engagement, not to be confused with length of thread, is the actual maximum amount of thread contact possible between two mating parts (Fig. 5).

It is a particularly critical dimension on translating threads, and has a direct influence in establishing the tolerances and allowances. It is an essential factor when ordering tools and gages and quite often determines their design.

Length of engagement should also be included as part of the specifications for any NS (National Special) series threads. Its inclusion is recommended when, in specifying any standard threads, a length of engagement exceeding one and one-half diameters is necessary.

Special Threads. A thread which deviates from any standard series as to diameter, pitch, and length of engagement is a special thread. There are countless ways in which a thread can become special, and the degrees of specialization are many. Consequently, when a special thread is chosen it is of the utmost importance that the designation be properly applied. The specifications should include all the pertinent data, in particular those features which make the thread a special one.

Both the American National and the American Unified thread series make provision for special threads having diameter or pitch or both that are different from those of the standard sizes in the respective series. Thus, as shown in Table 2, a National Special thread of a standard diameter and special pitch is shown as 1-29 NS. Another with special diameter and standard pitch is

shown as 1.020-20 NS. A third with both special pitch and diameter is shown as 1.020-29 NS.

In all three of the above mentioned cases, provisions are made by formulas and tables to enable the designer or specifier to determine the limits and tolerances for the pitch, major, and minor diameters.

Should a thread be an American National Special or an American Unified Special and one or more of these diameters are required to be different from that called for by the appropriate formulas or tables, the modified diameters are given and are followed by the designation MOD, as shown in the last two examples of Table 2.

When the thread is one of a standard series and some information is missing in the specification, it can be implied from the designation and vice versa. The machine operator usually has established information (for example, *Federal Handbook H28*) to support any interpretation he may have made. However, the symbols denoting that the thread is special alert everyone involved in its production. Interpretation will not be risked, for the possibility of error increases many times, thus the need for all the information appearing on the drawing is emphasized. The following are typical examples of how to specify special threads:

1-28 UNS-2A

Major Diameter .9989/.9924

Pitch Diameter .9757/.9717

Length of Engagement .250/.275

2 1/4-10 UNS

Major Diameter 2.250/2.231

Pitch Diameter 2.185/2.174

Length of Engagement 3" minimum

Precision Threads. Included in this category is a rather wide range of thread applications. Precision threads are those which by their very nature and ultimate use require extraordinary

care in manufacture. This same care must be exercised in their description and delineation to insure that when completed they are truly precise. Lead-screws, adjustment screws for astronomical and other scientific instruments, and the general run of threading tools (taps, die chasers, hobs, thread-rolling dies, thread plug and ring gages, etc.) come in this classification. Precision screw threads are generally ground.

Because of the more exacting requirements, and the far better control of accuracy inherent in the machines for producing precision threads, it is possible to specify and obtain elements usually ignored. The thread is designated in the regular manner, as completely as possible, but the bulk of the necessary information appears in the specifications. Some of these additional features are: width of crest and root, flank angle, lead taper, surface finish, and wire reading. Typical examples are shown in Fig. 6.

Wire Reading. The specifications in Fig. 6 include the wire reading, which is an interpretation of pitch diameter as measured over precision wires of a given size under certain fixed conditions. This method of measuring the pitch diameter is a commonly accepted and recommended method for use on precision threads. It is the responsibility of the draftsman to call for this method on the drawing by specifying the wire reading.

Together with the wire reading should be given the "best wire" size. In some instances it is well to include an alternate, in case the best wire

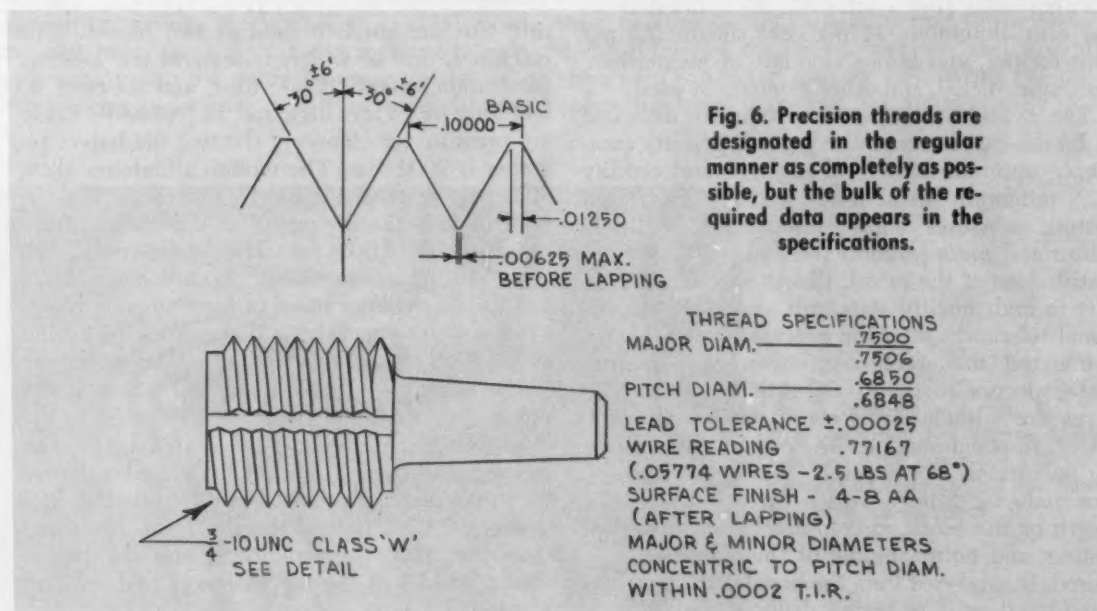
Table 2. Combinations of Diameter and Pitch Which Create Special Threads

EXAMPLE	DIAMETER	PITCH	DESIGNATION
1	STANDARD	SPECIAL	1-29NS
2	SPECIAL	STANDARD	1.020-20NS
3	SPECIAL	SPECIAL	1.020-29NS
4	STANDARD	STANDARD	1-20UNEF-2B MOD P.D. .9645/.9704
5	SPECIAL	SPECIAL	1.020-29NS-MOD MINOR DIAM. .970/.973

Note - In addition to the designation given above, the class of fit, pitch diameter limits, and length of engagement should be included.

is not available. The "best wire" is the one which contacts the thread flanks at the pitch line. While any alternate size may be used which contacts the flanks and at the same time projects sufficiently above the crests to permit taking a measurement, sizes at either extreme should be avoided.

The example shown in Fig. 6 is a precision master plug "Go" gage member, and not only is no alternate wire permitted, but the measurement must be taken at a fixed pressure and temperature. In the event the helix angle exceeded 3 degrees, the wire reading would have been calculated to incorporate the effect of the helix and would have appeared differently on the drawing.



Die-Casting Chrysler's Aluminum Engines



CHARLES H. WICK, *Midwestern Editor*

CHRYSLER CORPORATION'S inclined six-cylinder engine, which is optional equipment on its Valiant and Lancer cars, has a die-cast aluminum cylinder block that weighs 76 pounds less than a cast-iron block. Called a "Slant Six" because it is tilted 30 degrees to conserve space under the car hood, the in-line engine has a displacement of 225 cubic inches. The die-cast aluminum block has cast-iron, dry cylinder bore liners, which are in place when the block is cast. An aluminum alloy containing approximately 84 per cent aluminum, 11 per cent silicon, 3.5 per cent copper, and minor amounts of magnesium, iron, zinc, nickel, and other elements is used.

The cylinder block was specifically designed to be die-cast because the process permits combining optimum structural strength and rigidity with minimum metal usage and weight. High casting pressures allow minimum wall thicknesses and more uniform sections, with efficient distribution of the metal. Blocks are consistently cast to high quality standards and close dimensional tolerances, and the process permits highly automated manufacturing, materials handling, and inspection methods. Oil galleries and tappet bores are automatically cored when the block is cast, thus eliminating the need for many drilling operations. For example, the 5/8-inch diameter main oil gallery, which extends the entire length of the block, is completely cored in die-casting, and no machining of this passage is required. In sand-cast iron, the boss for this passage is solid and requires twelve drilling passes.

Also, with the close tolerances maintained in die-casting, only a minimum amount of metal has to be removed from other block surfaces during subsequent machining. Average stock removal is only 0.030 to 0.040 inch, compared to 1/8 inch or more with cast-iron blocks. About 0.090 inch of stock is removed from the cylinder bores in the die-cast aluminum blocks.

Engine blocks are die-cast at the corporation's own casting plant in Kokomo, Ind. Huge Cast-Master machines made by H-P-M Division, Koehring Co., are used to die-cast the blocks. The machines, one of which is seen in the heading illustration, weigh 12,000 tons, and measure 40 feet long by 14 feet high and 11 feet wide. Locking pressure for clamping the two die halves together is 2000 tons. The molten aluminum alloy, at a temperature of about 1215 degrees F., is injected into the die cavity at a pressure of approximately 18,000 psi. The water-cooled die assembly, which produces seventy cored holes and the six-cylinder bores in forming each block, weighs 45,000 pounds, and measures 83 inches wide by 60 inches high and 49 inches thick.

The casting die is designed with the cylinder axis in the horizontal plane, as illustrated in the cross-sectional drawing, Fig. 1. Crankcase core and mandrels which support the cylinder sleeves during casting are mounted in the stationary half of the die. This half of the die forms the three crankcase bays, the bulkheads, and the tappet bosses. Insides of the tappet bosses and the end camshaft bearings are cored.

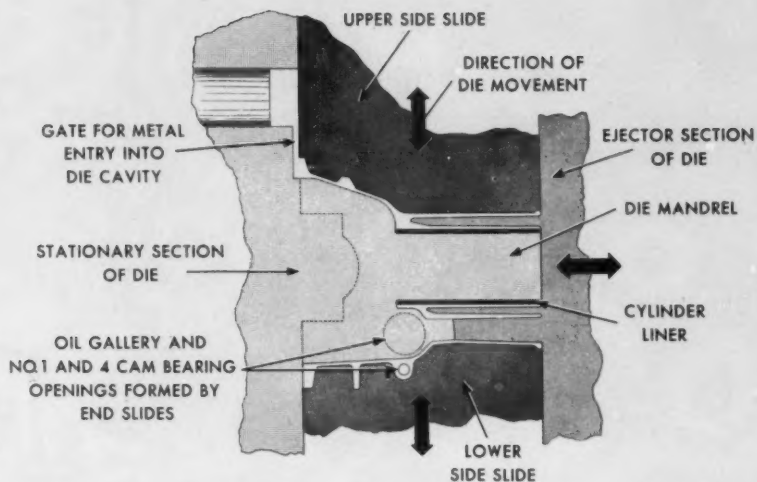


Fig. 1. Cross-sectional drawing of die for casting six-cylinder aluminum engine blocks. Cast-iron liners are in place when the block is cast.

The four sides of the block, as well as the cored-out top surface (water-jacket core and core forming the tappet chamber), are formed by sections mounted in the movable or ejector half of the die, Fig. 2. To allow the ejector half of the die to move, sections of the die forming the four sides are mounted on slides to provide means for retraction. In order to core the holes which are at angles to the direction of the slide movements and die openings, hydraulic cylinders are used. Hydraulic cylinders are also provided to core the oil-gallery holes because of the 13-inch core pull required.

Cavity surfaces of the die that contact the molten aluminum alloy are made from AISI Type H-13 chromium-base, hot-work tool steel. Other sections, including the die-retainer blocks, are made from various steels, including AISI 4140 and cast iron. The different die sections have a wide variation in life, with the cores for the hottest sections producing 12,000 or more blocks.

The installation is highly automated, with conveyors carrying the centrifugally cast iron liners to the die-casting machines, and separate conveyors transferring the cast blocks to subsequent operations. Aluminum-alloy ingots are melted in 30,000-pound capacity, gas-fired breakdown furnaces. The molten material is stored in holding furnaces, and transferred, as required, by mono-rail conveyor to a 2000-pound capacity, induction-heated furnace at each die-casting machine.

When the aluminum is cast around the iron cylinder sleeves, residual tensile stresses are set up in the aluminum due to the difference in contraction of the two metals. To reduce these stresses, the liners are preheated to approximately 800 degrees F. prior to making the castings. The hot liners are automatically transferred, six at a time, from an induction-heating unit to the mandrels on the die, the die halves close, and molten aluminum is injected into the die. When the die opens, the block is ready to be automatically un-

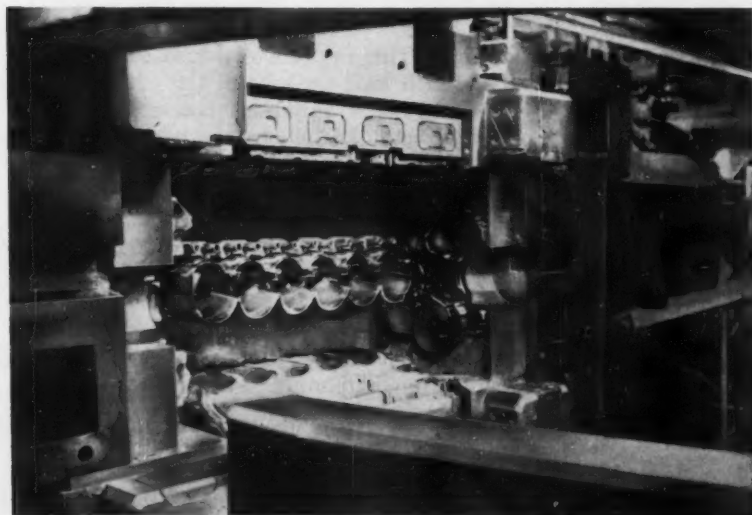


Fig. 2. Movable or ejector half of the die forms the engine block sides and the cored-out top surface. Side-forming die sections are mounted on slides.

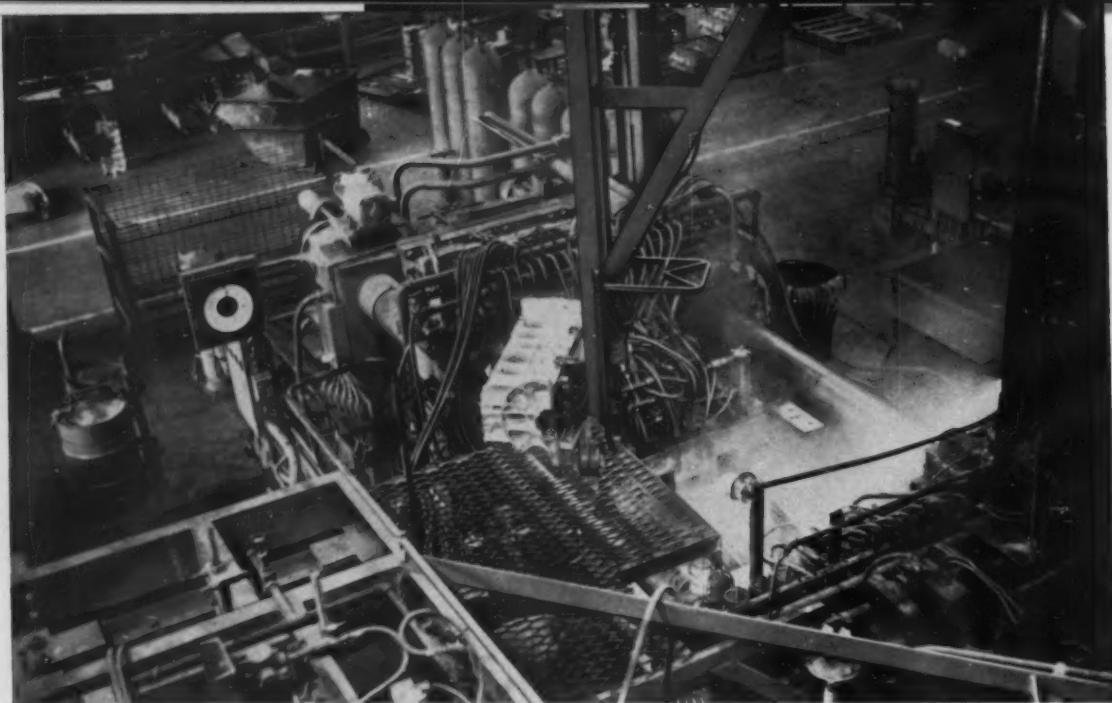


Fig. 3. In automatic unloading, the die-cast block is lifted vertically from machine and transferred to inspection table shown in the heading illustration.

loaded. This is accomplished by lifting vertically from the machine, swinging through an arc of 135 degrees (Fig. 3), and lowering onto the inspecting and unloading table.

Only one man is required per die-casting machine, and is capable of producing twenty-five blocks per hour. He sprays the die between casting cycles with a releasing and lubricating agent consisting of mineral-seal oil and additives such as colloidal graphite, and inspects and numbers each block. Subsequent operations consist of trimming the flash, blasting with aluminum shot, a Magnaflux inspection, and pressure testing for leakage. An important advantage of the Chrysler technique is that practically none of the die-cast aluminum engine blocks have to be impregnated. They are 100 per cent pressure-tested for water leakage after machining, and only a few require impregnation. Also, no aging or heat-treatment is necessary for stabilization.

As-cast, aluminum engine blocks weigh 90.5 pounds, with the iron liners. Of this weight, 69 pounds are aluminum. The trimmed weight is 77.4 pounds, and the blocks weigh 64 pounds when fully machined. Combined thickness of the iron and aluminum which make up the cylinder bore walls is 0.21 inch, and the engine has bore center spacings of 3.98 inches. With a 3.40-inch diameter cylinder bore, the minimum water-jacket thickness is 0.16 inch between cylinder bores. After machining, the centrifugally cast iron liners are 0.100 inch thick, and the aluminum alloy around them is 0.110 inch thick (at the top

of the bore, where the aluminum is thinnest due to the 1/2-degree draft of the water-jacket core).

Savings in Machining

In addition to the elimination of many subsequent machining operations that would be required with cast-iron blocks, and the reduced amount of stock removal necessary as the result of close-tolerance die-casting, the lower hardness and higher machinability of aluminum permit a reduction in cutting time of approximately 50 per cent. Higher speeds and feeds can be used for all machining operations, less equipment is needed, and production costs are lower.

For example, in semifinish milling the oil-pump pad on cast-iron blocks, the 4 1/4-inch diameter cutter is rotated at 136 rpm and fed at the rate of 28.7 ipm. This requires eighteen seconds for the 8 1/2-inch long traverse of the cutter. With an aluminum block, only ten seconds are needed with a feed rate of 50.8 ipm and a cutter speed of 255 rpm. In drilling an oil-feed passage hole 1/4-inch in diameter by 1.92 inches deep, twenty-two seconds are required in cast iron, using a feed rate of 5.3 ipm and a drill speed of 1064 rpm. In aluminum, this operation requires only eleven seconds, using a feed rate of 10.2 ipm and a speed of 1710 rpm. Another advantage of machining aluminum is that the tool life, or pieces machined between cutter sharpenings, averages three times that for cast iron. This results in reduced down time and tool costs.

Inspection of Chem-Milled Parts Simplified by Resonance Gaging



HOW do you measure the wall thickness of 13 1/2-inch outside-diameter tubing at any point along its 20-foot length, to micrometer accuracy? Faced with this question, Altamil Corporation, Indianapolis, Ind., found the answer in ultrasonic resonance gaging.

The Vidigage, made by Branson Instruments, Inc., Stamford, Conn., permits nondestructive thickness measurements even when access to only one side is possible. In this way tubing walls, large sections of sheet metal, hollow cylindrical parts, aircraft wings, and fuselage sections can be measured for thickness quickly and accurately at any desired location.

To fabricate components with improved strength-to-weight ratios for supersonic aircraft, rockets, and missiles, Altamil uses chemical milling. This relatively new process provides weight reduction in metal parts by etching them in acid-filled tanks. The duration of immersion determines the depth of the cut.

The Vidigage uses ultrasonic resonance to make direct-reading thickness measurements of 0.005 to 2.7 inches, within accuracies of 0.1 per cent. Even more accurate readings are possible

Working from the outside only, the operator watches the traces on the television tube that tell him the wall thickness of a large tubular section at any point.

with automatic recording equipment, and thicker sections can be gaged by extrapolation.

A piezoelectric transducer in a probe converts electrical impulses into mechanical vibrations. When the transducer is placed in contact with the surface of the metal under test, inaudible sound waves, continuously varying between 0.7 and 25 megacycles, are sent into the metal. Returning (echo) waves in the metal are picked up by the transducer, and fed back into the electronic circuit where resonant frequencies are amplified to display one or more traces on a cathode-ray tube. A calibrated scale in front of the tube permits direct reading of thickness, which is inversely proportional to the resonant frequencies.

Because the gage essentially measures the distance from the surface to the first discontinuity, the instrument may also be used for detecting voids, laminar flaws, and weak bonds in clad or roll-bonded sections, as well as for corrosion inspection.

Heat-Treating High-Speed and Tool Steels

A hardening process that is fully automatic and produces a bright finish on all high-speed and tool steels has been announced by Ipsen Industries, Inc., Rockford, Ill. The process maintains correct surface-carbon concentration, holds distortion to a minimum, and reduces the cost of operation to less than one-half that of salt-bath treatment.

Basic equipment used is a modified Ipsen vacuum unit. The work is first placed in a basket on a charging platform. The operator then manually opens the door, swings the loading platform into position in front of the unit, and rolls the work-basket into the furnace. (Special ceramic rollers

inside the furnace support the load during both the heating and cooling cycles.) Then the platform is swung aside and the furnace door is sealed.

Preheat soak time and high-heat soak time are set at the control cabinet. When the start button is depressed the unit automatically performs all functions, and upon completion of the last cycle a bell signals the operator that the work can be unloaded. Since the work is protected from oxygen and other oxide producers during the entire heat-treating cycle the surface remains clean and bright and surface carbon is not depleted.

Tool Engineering IDEAS

Tools and fixtures of unusual design and time- and labor-saving methods that have been found useful by men engaged in tool design and shop work



Dies Bend Tubing Without Galling

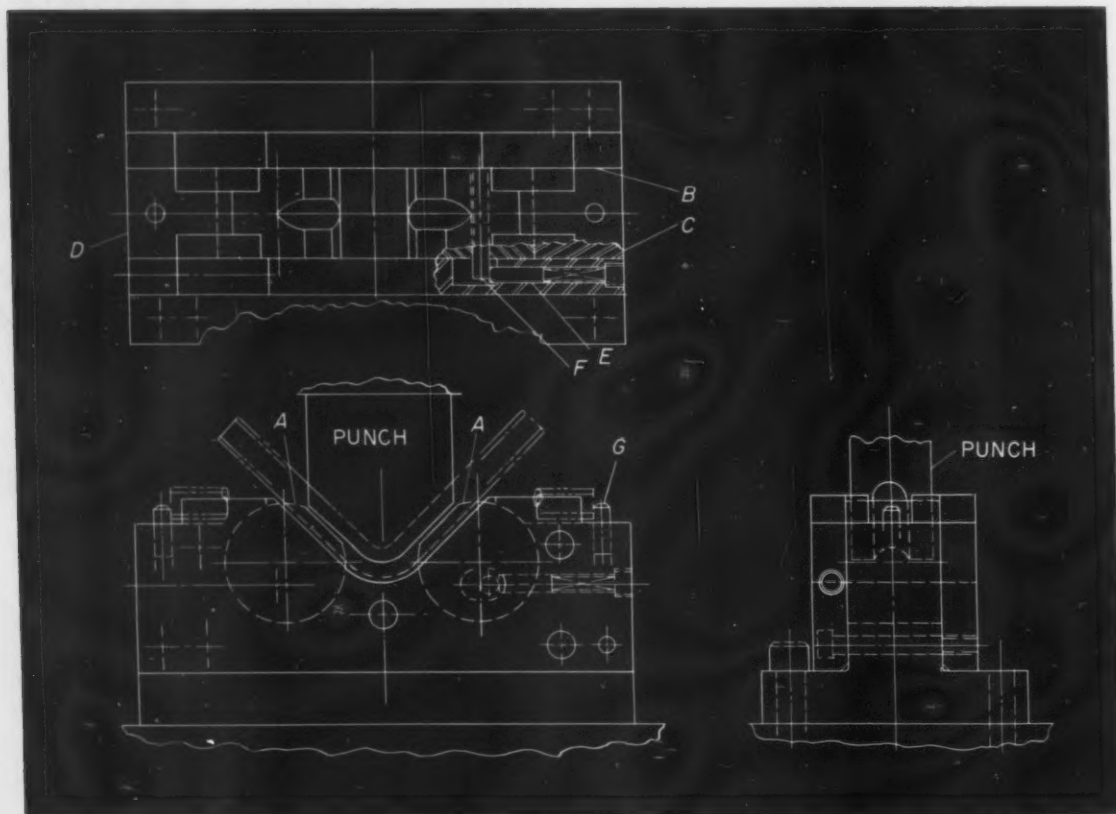
M. W. LOFTUS, Chicago, Ill.

Quality in bending seamless steel tubing comprises getting accuracy in the bend, smoothness of contour, and keeping the surface free from scratches and galling by the dies. The dies illustrated were designed for forming a 90-degree bend in a punch press.

To prevent excessive marring of the surface, the dies were built with the lower member con-

sisting basically of cylindrical pivoting form-blocks A. Rounded grooves are ground in the blocks to cradle the largest diameter of tubing to be formed. The blocks have bearings in side-plates B and C, which are supported by plate D.

The punch has a groove identical to that in the form-block. Spring-loaded plungers E, on both blocks, bearing against pins F, return the blocks



Improved angle uniformity and freedom from galling are the advantages of designing tube-bending tools with rotating form-blocks (A).

to the loading position at the end of each press stroke. When the dies are in open position for loading, both blocks have turned so that the grooves face upward in horizontal alignment. Rotation is stopped by pin *F* striking the wall of its clearance pocket in plate *C*.

Holder *D* is made wide enough to provide additional bearing surface at the top and at the ends of the form-blocks. Because side-plate *C* has a stop surface for pin *F*, it is doweled to holder plate *D*. But plate *B* needs no dowels. The same

screw fastening holds both side-plates in position. Gage pins *G*, at each end of the die, position the parts at loading. Depth stop-blocks, not shown, are mounted on the die set to speed setup and control the angle formed.

While the cost of rotary forming dies is possibly somewhat greater than pad type dies, the bent tubing is always acceptable as it comes from the dies. This set of dies was designed for low costs in manufacture and maintenance. The high quality of product cuts scrap loss.

Low-Cost Drill Jig Made of Structural Shapes

ROGER ISETTS, Kenosha, Wis.

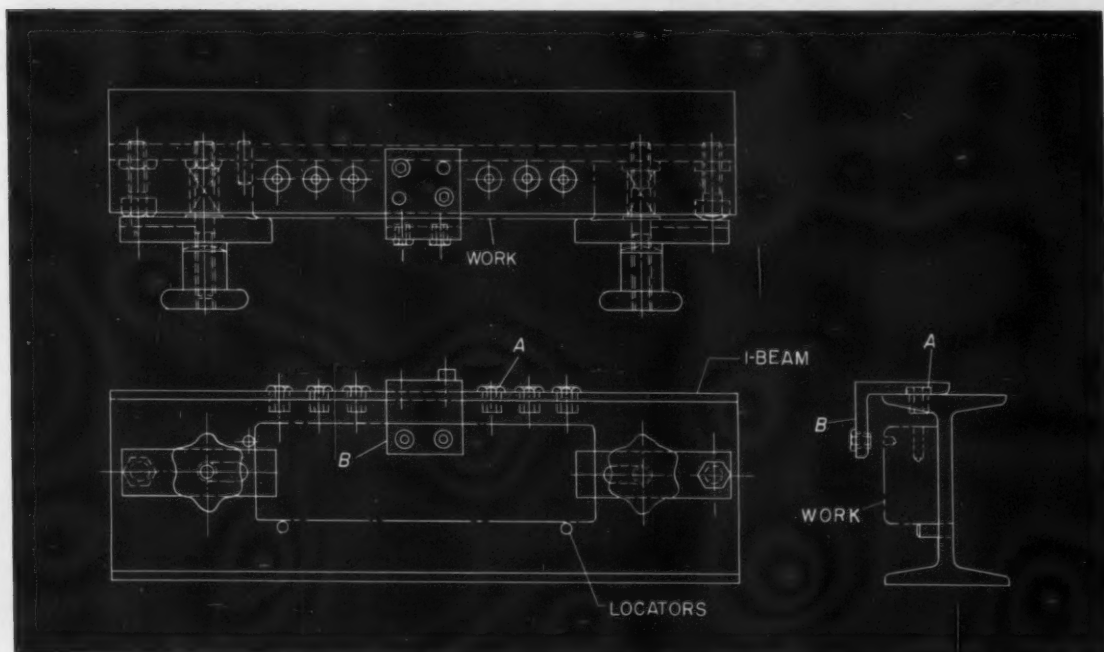
Not a great deal of accuracy was required in a farm-implement component, and the quantity to be made was not great, but it was still highly impractical to lay out each piece separately for a number of drilling operations. Because of the low production, tooling costs had to be held to a minimum. This presented a problem, since holes had to be drilled in two different planes at right angles to each other.

The problem was solved by the selection of length of standard structural I-beam for the main body of a tumble jig. As may be seen from the illustration, the I-beam served the multiple purpose of the jig base, upright, bushing plate, and feet for drilling in two directions. Finishing of the

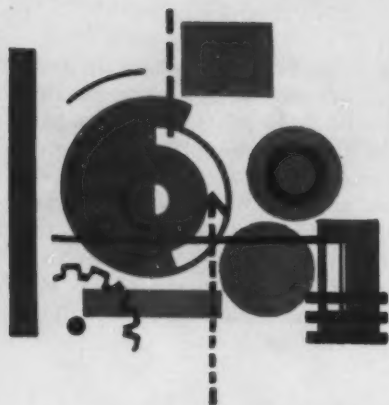
I-beam was not necessary to achieve accuracy.

Three standard dowel-pins were pressed into the web of the beam to serve as work locators. Four holes were tapped in the web to receive clamps, studs, and heel screws. The clamps were of the ordinary hand-knob strap type and were purchased complete from suppliers.

Six drill bushings *A* were provided in holes drilled along the top of the beam. Two additional drill bushings were provided in bushing plate *B*, which is simply a piece of standard structural angle iron. The angle iron was screwed to the beam flange by socket-head machine screws and doweled in place. While the design of the jig was most simple, it served its purpose well.



Tumble type drill jig constructed inexpensively by using structural shapes.



Ingenious Mechanisms

Mechanisms selected by experienced machine designers as typical examples applicable in the construction of automatic machines and other devices

Ratchet Operates on Alternate Strokes

L. KASPER, Philadelphia, Pa.

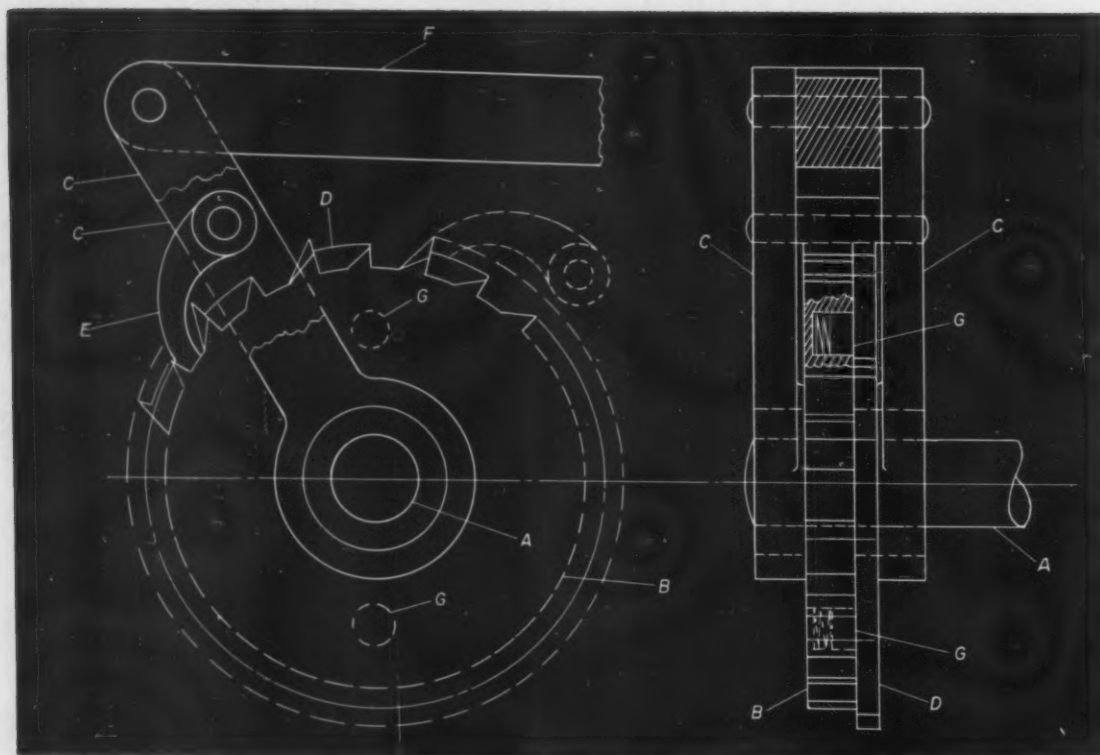
A dual ratchet-wheel system provides the required rotation of a shaft only on alternate strokes of a reciprocating drive lever. The drawing shows the mechanism at the end of a power stroke.

Driven shaft *A* and ratchet wheel *B* are keyed together. This wheel has a hub on each side; one side carries one lever *C*, and the other side, pilot wheel *D* and a second lever *C*. Both levers and the pilot wheel are free on the hubs. Pawl *E* is pinned between levers *C*, and is wide enough to engage

the teeth of both wheels. Reciprocating drive lever *F* transmits motion to both levers *C*.

Teeth of ratchet wheel *B* are the usual shape, except that there is somewhat greater spacing between them. On the other hand, the teeth of pilot wheel *D* are a special shape, as shown.

With the levers in the position illustrated, at the end of a power stroke, the pawl has engaged one tooth of ratchet wheel *B* and rotated it to the limit of lever movement. It will be noted that the



The design of the teeth of pilot wheel (*D*) keeps pawl (*E*) out of engagement with ratchet wheel (*B*) on alternate oscillations of levers (*C*).

radial contact faces of the teeth of wheels *B* and *D* coincide, and since the pawl is wide enough to engage both wheels, they have been rotated in unison.

The pawl is shown in broken line at the end of the subsequent return stroke. Here, it is in contact with one tooth of pilot wheel *D*, but is raised out of contact with the ratchet wheel *B*. On the next power stroke, the pilot wheel is rotated, but no motion is transmitted to the ratchet wheel, and therefore no motion to the driven shaft. At the end of this power stroke, the pilot wheel will come to rest so that the contact face of the tooth will coincide with the contact face of one of the teeth in the ratchet wheel.

Then, at the end of the next return stroke, the pawl will again be in position to fall into contact with one tooth on both wheels. In this way, the required shaft rotation on alternate reciprocations of the drive lever is obtained: on one power stroke, both wheels are rotated in unison, and the motion is transmitted to the driven shaft; but on the subsequent power stroke, the ratchet wheel

is not rotated, since the pawl is held up.

Two spring-loaded plungers *G* are contained in the ratchet wheel, bearing against the adjacent face of the pilot wheel. By applying a light frictional resistance to the pilot wheel, they prevent any backward rotation due to the drag of the pawl on the return stroke.

The mechanism will operate regardless of the angular oscillation of levers *C*, with the limitation that the pawl always must move an uneven number of teeth, such as one, three, or five. If the pawl were to move an even number of teeth, such as two, four, or six, the ratchet wheel would be rotated on each oscillation, rather than on alternate oscillations as required. This, in itself, may be an advantage, in some instances, in that it is possible to vary the driven-shaft rotation from alternate to consecutive action merely by changing the range of oscillation of the levers, to increase or decrease the movement of the ratchet wheel. There must, of course, be an even number of teeth or contact faces on both the ratchet wheel and the pilot wheel.

Vacuum Pickup Extender Obviates Lifting Heavy Stacks

H. B. SCHELL, Brooklyn, N. Y.

Most vacuum pickups for sheet stock work nicely as long as the stock pile is full. However, when the stack of sheets starts to decrease in height, provision must be made to jack up the stock table so that the vacuum cups can continue to reach the top sheet in the stack.

A simple solution to the problem is the pickup extension device shown in the diagram. The shank of the vacuum cup moves downward automatically as the pile is used by the press. The use of these devices allows piles of sheet material over 4 inches high to be fed into presses without lifting the stack.

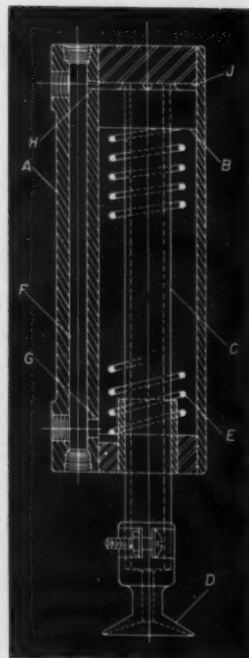
The lift consists principally of cylinder *A*, piston *B*, hollow piston-rod *C*, vacuum cup *D*, and spring *E*. The entire assembly is secured in the proper location on the feeding device by cap-screws in the tapped holes shown in the side of cylinder *A*. The vacuum line is connected to one of the pipe-tapped holes at either end of duct *F*; the other end is plugged. All other openings, of course, are plugged.

The device functions as follows: when a pickup is desired, the vacuum valve is automatically opened by a cam, or other means. Note that the lower port *G* is much larger than the upper port *H*. Upper port *H* is actually a leak from space *J* to the atmosphere at this stage of operation. The vacuum formed below the piston *B* causes the

piston and rod assembly to move downward. The space *J* above piston *B* is still at approximate atmospheric pressure because there is an air passage through the vacuum cup and the hollow piston-rod to space *J*. Downward movement continues until the vacuum cup *D* contacts the pile of sheets. Upon contact, air passage to space *J* over the piston is closed and a vacuum is set up. Because both ends of the cylinder are now in pneumatic balance, the spring *E* is free to lift the piston assembly upward together with the adhering sheet.

At the proper time, the sheet is dropped by releasing the vacuum. The drop may be hastened by the introduction of some air pressure into the system.

Vacuum lifter grabs sheet on contact, and will handle the whole of a big stack.



Cold S-t-r-e-t-c-h for High Strength

INTENSE HEAT has been replaced by severe cold in a new metalworking process developed by Arde-Portland, Inc., Paramus, N. J., to produce significant improvement in the strength and ductility of steel vessels and tubing. A prime attraction of this process—called Ardeform—is that no heat-treating furnace is required and so it is not limited by product dimensions. To date spheres up to 16 inches in diameter and cylinders up to 4 feet in length by 12 1/2 inches in diameter have been fabricated.

Units produced so far have demonstrated nominal tensile strengths of 285,000 psi. With suitable design and material selection it is expected that nominal tensile strengths in the neighborhood of 400,000 psi can be reached.

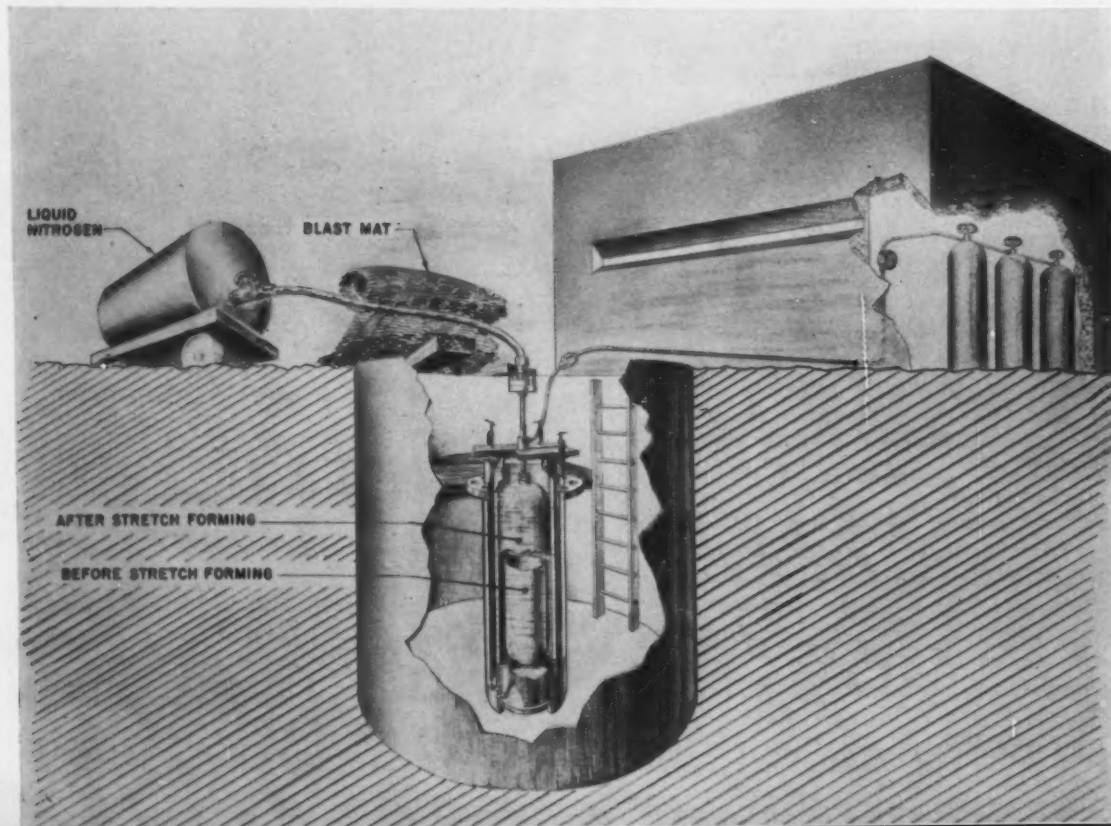
Ardeform is essentially a cryogenic stretching process. It is based on the principle, discovered some time ago, that cold-working at cryogenic temperatures markedly improves the room-temperature strength of austenitic stainless steels. The full strength of these cold-worked



Fig. 1. Two pressure vessels fabricated of AISI 301 stainless steel. Vessel at the left is unstretched preform with a nominal tensile strength of 102,000 psi. The one on the right has been stretched approximately 13 per cent, with a resultant increase in nominal tensile strength to 260,000 psi.

steels in fabricated units requiring welding was not previously attained because the heat produced by welding reduced the local yield strength by more than 80 per cent. Now, the unit is first formed and then worked so that the welds as well as the base material are strengthened.

Fig. 2. Sketch of Ardeform pilot facility now in operation at the company's plant in South Portland, Me. Large outer pit is 12 feet deep and 10 feet in diameter. In the center of the pit is the insulated forming tank containing the forming die and the preform. Liquid nitrogen is supplied from the small trailer at the left, while high-pressure nitrogen gas is piped from the black-house at the right.



The first step in Ardeforming is the fabrication of an undersize vessel, called the preform, from annealed sheet stock. Although inexpensive roll and weld techniques are used, good weld-quality standards must be maintained to permit the sizable amount of stretching (up to 13 per cent in diameter) that takes place.

The preform is then placed inside a stainless-steel forming die located in a below-ground-level forming tank. Liquid nitrogen flows into the tank to a level well above the preform. The preform is then filled with liquid nitrogen and sealed off except for a pressurizing line which leads to a supply of compressed nitrogen gas.

When the preform reaches liquid-nitrogen temperature—minus 320 degrees F.—the pressurizing

line is opened and the work is expanded by gaseous nitrogen. A sharp rise in pressurization rate indicates that the preform has contacted the die. After stretching, a vent is opened to release the pressure. The vessel is then removed from the forming tank, emptied of liquid nitrogen, and returned to the plant for final machining. Of the stainless steels used, AISI 301 appears best suited because it achieves its maximum strength with a minimum of working.

Developed primarily for the fabrication of large, high-strength, solid-propellant rocket cases, the process is also expected to find application outside this field in the fabrication of thin-wall pressure vessels, mobile cryogenic storage containers, and high-strength tubing.

Machine Tool Programming System for Univac Solid-State Computers

A versatile automatic part-programming package for numerically controlled machine tools has been developed for Univac solid-state 80 and 90 computers. Automatic part programming for different machine tool control systems is now possible using a single numerical-control programming system utilizing a medium-scale, general-purpose digital computer. The new system is the product of a joint development effort conducted by the Rohr Aircraft Corporation, Chula Vista, Calif., and the Univac Division of Sperry Rand Corporation, New York City.

A complete software package will permit automatic part programming for the following numerical controls: Cincinnati, Numericord (G & L), Bendix Digimatic (E.C.S.), and Thompson Ramo Wooldridge. Univac-Rohr programs have been proved in use on nine different numerically controlled machine tools in Rohr's plant.

Programs for the tool-control systems will be available to all users of Univac solid-state computers without cost. In addition, metalworking firms operating on a job-lot basis can utilize the facilities of a Univac service center to perform automatic part programming. This service is expected to be especially important in enabling small- and medium-size shops to obtain more fully the production benefits of numerical control.

From Blueprints to Control Media

After an engineering drawing is made giving specifications of the part to be machined, appropriate descriptive information is transferred to a part programmer's manuscript. This document contains a minimum of data relating to part

geometry, feed rates, spindle speeds, and auxiliary machine tool instructions.

Computer input cards are then punched utilizing the data on the program manuscript. These cards are fed into a high-speed reader for transmission to the central processor of the Univac solid-state computing system. At this point, general part descriptions and tool instructions are interpreted, compiled, and encoded according to an internally stored computer program.

The resulting output cards, which are punched on a read-punch unit, contain precise and detailed instructions for the control system of the machine tool which will produce the part. For machine tools which cannot accommodate a control card input, appropriate conversion to a control tape is made.

A Step Further

Univac Division is also working on the development of an advanced automatic-programming system for the recently announced Univac 1107 thin-film memory computer. This is the APT III (Automatically Programmed Tool) system which is now being designed by a study group of the Aerospace Industries Association. Memory access speeds for the 1107 thin-film computer are measured in billionths of a second, as against millionths of a second in the fastest current computers.

It is said that the field of numerically controlled machine tools is only in its infancy. Knowledgeable authorities have estimated that 90 per cent of machine tool production may be accomplished through automatic controls by 1970.

High-Speed Master Cams Generated Mechanically

(Continued from page 99)

held to tolerances well within 0.0001 inch in point-to-point radial variation, and well within 0.0005-inch total variation. Such cam masters will have a surface finish between 8 and 11 micro-inches, just as they come off the jig borer. To rough and finish the average single cam by this procedure, and cutting every 1/2 degree of rotation, using two men as described, requires about four hours' elapsed time, for a total of eight man-hours. By other methods that would achieve the same degree of accuracy, the required time would be at least forty man-hours.

The third phase in the cam-making program is to produce the hardened, finished prototype cam for use in the model machine. The narrow-faced, relatively soft, high-precision master cam produced on the jig borer must control, without appreciable loss, the finishing of the final hard cam.

At the time this method was being developed, no suitable equipment could be purchased to carry out this operation in a satisfactory manner. Most commercially available equipment used pantographic linkage to control the grinding wheel, or else was controlled by a master and simple follower system too remote from the grinding wheel to have the sensitive response desired. Therefore, the laboratory developed a cam duplicator that not only meets specifications, but produces a blended cam surface actually better than the original jig-bored master.

A survey of data concerning high-speed cam designs that had met acceleration requirements revealed no case where the radius of curvature was less than 1 inch. This meant that rarely, if ever, would a grinding wheel of less than 2 inches in diameter be required to finish-grind a cam if the grinding axis were held parallel to the cam axis during the grinding operation.

On this basis, a toolroom type cam-master duplicating machine was designed and built incorporating these functional specifications:

1. One-to-one duplicating ratio;
2. Duplication follower diameter and corresponding grinding wheel diameter between 2 and 4 inches;
3. Direct coupling between the follower and the wheel, with their axes parallel;
4. Common counterbalancing and adjustable gravity loading of grinding wheel and follower;
5. Common shaft for adjacent mounting of master and part;
6. An instrumentation system to dynamically

compare the master with the part during the grinding operation.

Incorporating high precision and a fundamentally stable design resulted in a cam grinder that meets these six specifications, while providing other desirable work features. The unit, illustrated in Fig. 5, is a highly sensitive machine capable of exacting performance with excellent repeatability. The oversize follower (Fig. 6), by bridging the control points on the master with a larger circumferential surface, controls the finish-grinding operation with blended continuity better than the original master. The result is a smoother contour and better surface finish.

Of crucial importance is absolute control of the timing hole location with angular reference to the cam contour phase. This is essential in any complementary system using separate cams. Angular precision is achieved during grinding by mounting the original cam master and the blank on a common shaft, with the timing holes in each oriented by a common pin or dowel. Shaft and dowel holes are carefully honed to fit. This setup is shown, wheel raised, in Fig. 7, and in operating position in another view, Fig. 8.

With the constant comparing instrument, the effect of wheel wear, loading, and other cutting variables can be monitored and, therefore, closely controlled. Experience has proved this type of device to be remarkably insensitive to minor diameter variations in wheel-to-follower sizes. Variations of 0.020 to 0.030 inch in wheel diameter can usually be tolerated without detectable loss of accuracy. It is true, however, that cams having severe pressure angles call for closer control of wheel size. The company's experience to date indicates that in all cases the available control of wheel size on this machine is satisfactory.

After inspection, the cams thus made are used in the engineering of prototype calculating machines and computers. Hardened cams produced in this phase may also be used as production masters for cam manufacture and also as inspection masters to provide production quality control for production cams.

This procedure for making superlative prototype and master cams is still being refined and improved. Engineers desire cams accurate to the fifth decimal place, because such parts, it is hoped, will minimize fretting and noise. IBM engineering expects to improve shop methods of cam fabrication to such an extent that this goal will be reached.



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THINKING WITH MANAGEMENT

LOOK FOR GOOD MANAGEMENT!

THE MAJOR PROBLEM encountered with most business acquisitions in diversification programs is the caliber of the management that is acquired with a new concern. Men who have participated in large-scale diversification programs agree almost to a man that the caliber of the management you secure when buying a business is really the key to success. There are many factors that need to be scrutinized and analyzed carefully, but the one basic thing you must get is good management.

If you are buying other businesses producing and selling product lines similar to your own and using the same channels of distribution that you use, the need for acquiring good management with the business is not as acute as when you are entering a new field. This statement is based upon the assumption that you already have some depth of management talent and that your own men will be familiar with the kind of problems found in the new plant so that some of them could step in and run it successfully. In fact, if you have existing astute management, you can sometimes pick up poorly managed companies and convert them into profit-making enterprises.

The head of one large diversification program had a list of twelve acquired concerns that had

what he called professional management. That is, the men running the company were not the owners and were making a profession of management. Each one of these companies had been successful. There was a second list of thirteen firms run by former owners. Only seven of these were considered successful, the remaining six being unsuccessful, primarily because the former owners were not performing efficiently as managers.

Why did six companies "go sour"? Remember that these continued operation under the direction of former owners who had been successful in the past. In practically every case, the former owners had received several million dollars as a price for their businesses. They then had no more incentive to promote their businesses and had cash to spend in indulging themselves. The removal of an extremely strong incentive plus cash "in his pocket" apparently proved to be the ruination of each man as a manager. This clearly emphasizes the importance of incentives, even to top management. Several of the companies which went sour were later rescued by good professional management.

If you buy a company and hope to keep the original owner as an effective manager, do not give him all of his money or stock at the time of the acquisition. Make the payment contingent upon a continuing and reasonable profit over a period of years. This will provide an incentive for a continuing high-level performance. It will also give you the time required to recruit permanent management.

Slide Chart for Metal O-Rings

A simple-to-use slide chart for assisting design and production engineers in the specification of metal O-rings has been brought out by the Advanced Products Co., North Haven, Conn. The chart covers ring diameters from 1/4 to 50 inches and includes specifications for plain, plated, and coated rings. By setting the slide at the desired nominal outside diameter for any standard ring,

the proper installation dimensions may be quickly determined. Complete data on calculating installation dimensions for nonstandard ring sizes are also given.

Slide charts are available by writing on company letterhead to Arthur Hostage, sales promotion manager, Advanced Products Co., 59 Broadway, North Haven, Conn.

NEW

DEVELOPMENTS IN

Machine tools, unit mechanisms, machine parts, and

Roller-Burnishing Machine for Front-Wheel Spindles

The manufacture of automotive components on which safety depends demands that every possible precaution be taken to prevent their failure in service. In the case of front-wheel spindles, the Ford Motor Co. has found that roller-burnishing the radius where the spindle shaft projects from the spindle assembly strengthens that area and lessens the chance for fatigue cracks to develop. Working with Ford engineers, the Michigan Tool Co., Detroit, Mich., has designed and built a special machine to perform this operation efficiently and economically. Designated the Roto-Flo Model 1026 roller burnisher, Fig. 1, the machine makes use of two rollers under hydraulic pressure to burnish the fillet. The wheel-spindle assemblies are made of 5132 steel and are ground before burnishing the fillet radius.

In operation, a spindle assembly is placed in the machine and the operator presses the cycle button. The machine spindle rotates and the two tool-slides move in hydraulically until the rollers contact the radius as seen in Fig. 2. The rollers are mounted in the tool-holders so that they are free to move axially and therefore center themselves in the radius. Under 60-psi hydraulic line pressure, they cold-work the fillet for fifteen to seventeen seconds, retract, and the machine stops. This complete cycle is automatic and requires only loading and unloading by the operator.

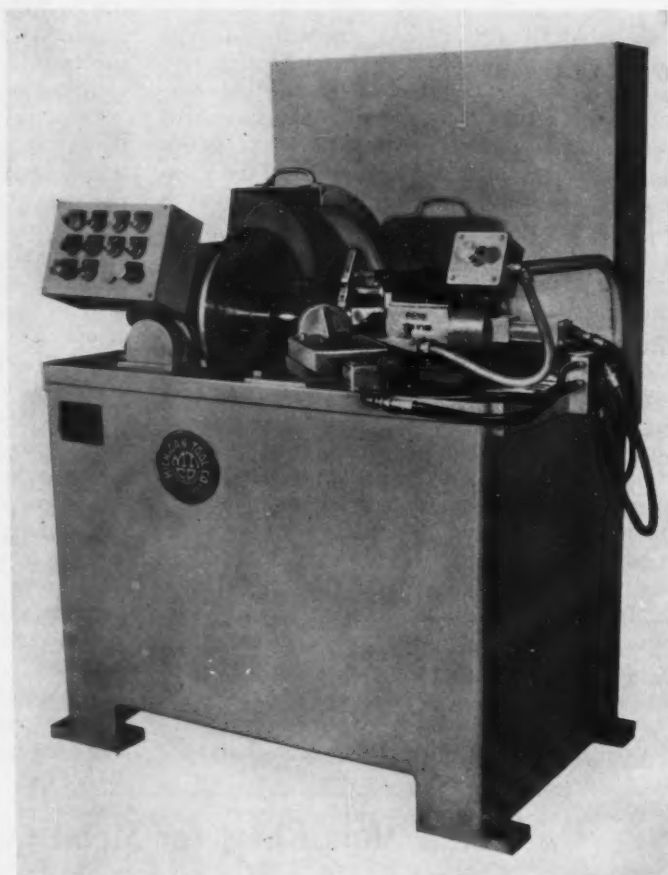


Fig. 1. Roto-Flo roller burnisher that strengthens automobile front-wheel spindles by cold-working critical fillet

The design of the burnishing rollers causes them to work the fillet surface evenly and prevent tool marks. This is achieved by

using two different cross-sectional radii on the circumference of the rollers, Fig. 3. As the rollers contact the rotating wheel-spindle

Edited by Freeman C. Duston

SHOP EQUIPMENT

material-handling appliances recently introduced

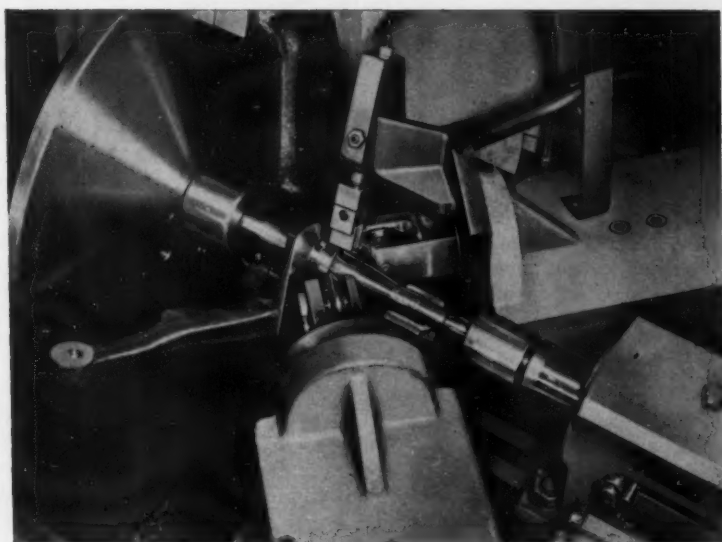


Fig. 2. Two burnishing rollers, 90 degrees opposed, move in and are held, under hydraulic pressure, for preset time while work-piece rotates

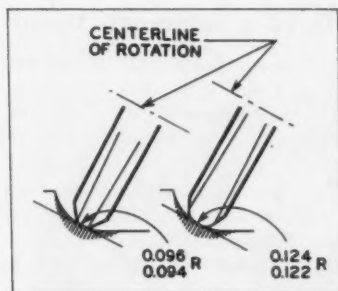


Fig. 3. Different cross-sectional radii on roller circumference cause rolls to work fillet evenly and prevent tool marks

and revolve, they are held under constant hydraulic pressure and the contact line of roller to work-piece moves up and down the fillet because of the two different radii machined on the roller edges (see Fig. 4). The roller's radii are blended smoothly into each other by stoning the meeting edges, and

the rolling surfaces are polished to a 5-micro-inch finish. Production is at the rate of 102 pieces per hour, and tool life is approximately 5000 pieces. The design of the machine is such that simple retooling can convert it to a different-size wheel-spindle.

Circle 565 on Readers' Service Card

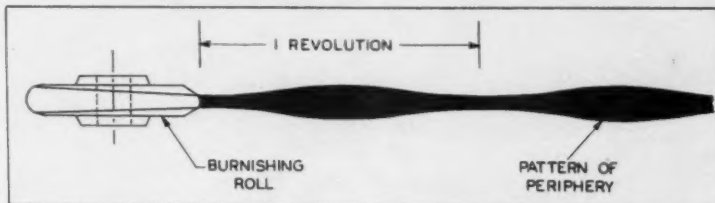
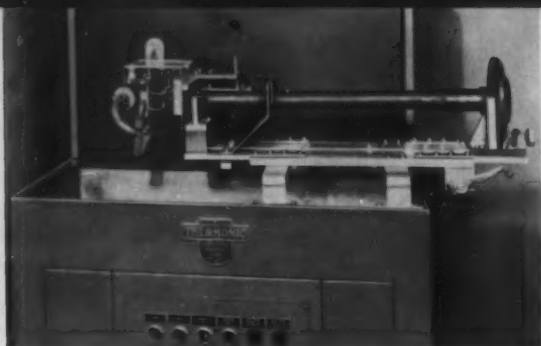
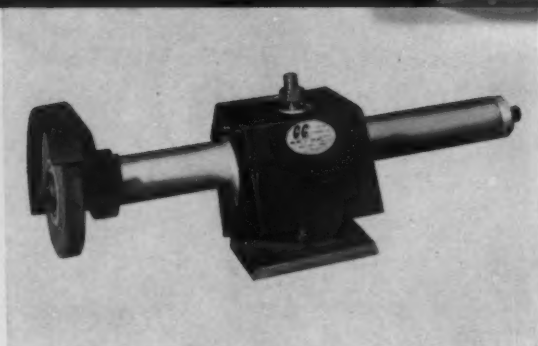


Fig. 4. Effect of two different radii on the burnishing rollers is shown graphically by simulated ink trace of roller



Ther-Monic unit developed for flat-surface hardening end of tractor axle



Air-operated toolpost grinder developed by Gilmore Industrial Grinders, Inc.

Heating and Quenching Unit Developed to Produce Uniform Depth of Case on Flat Surface

A new work-coil developed and patented by the Induction Heating Corporation, Brooklyn, N. Y., subsidiary of Hathaway Instruments, Inc., is said to eliminate soft spots in flat-surface hardening. The pancake type of work-coil previously used, because of its inherent geometry, left a soft spot in the center of the hardened surface. The new work-coil eliminates this flaw and is readily adaptable to jobs where uniform depth of case on a flat surface is required.

The entire heating and quench cycle—from start to finish—takes approximately twenty seconds, and is controlled by an electronic timer which can be started either automatically or manually. The coil is energized by a 20-kw generator. This Ther-Monic unit is

completely self-contained. It is mounted on a single-position, sink type work-table which contains all necessary valves, electrical controls, and output transformers.

Gilmore T-P Toolpost Grinder

A toolpost grinder has been developed and is being marketed by Gilmore Industrial Grinders, Inc., Houston, Tex., which uses the same quill for either internal or external grinding operations. Complete visibility during all grinding operations is assured, because the grinder is operated by a 1-hp air motor completely enclosed inside the 1 1/8-inch diameter quill. This motor has a top speed of 18,000 rpm and operates through 4-to-1 ratio reduction gears to produce a maximum spindle speed of 4500

In this particular application it is used for hardening the end surface of a tractor axle to resist end thrust wear. The axle is mounted in the loading position on the fixture and moved by crank into the heating position.

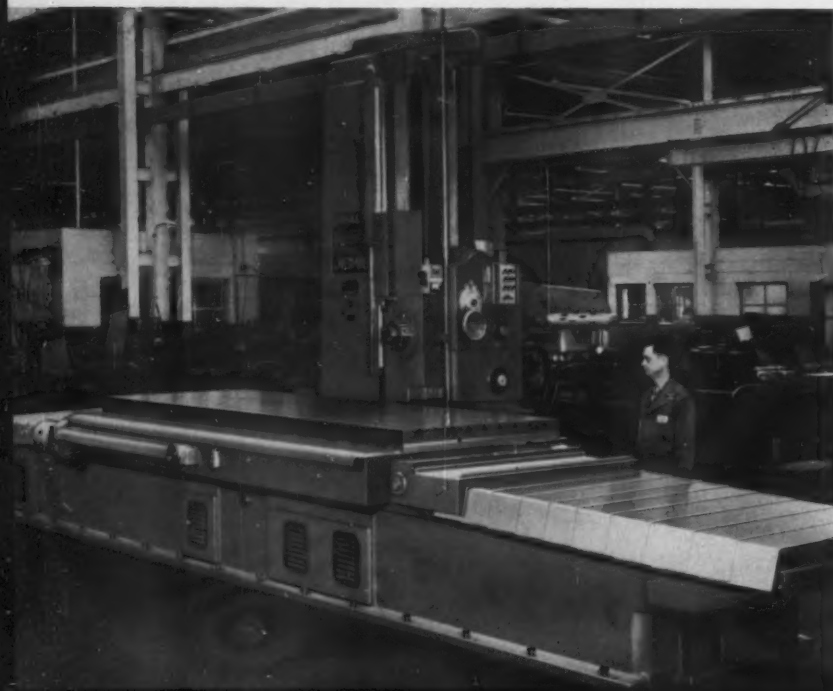
Circle 566 on Readers' Service Card

rpm. Grinding speed can be changed simply by adjusting the air-supply valve.

The quill assembly is mounted on the lathe compound rest by means of a support block which includes an eccentric. Only one bolt is needed to lock the eccentric in place. The eccentric provides a 7/8-inch vertical adjustment of the quill, assuring ease in moving the grinder to lathes of varying sizes. There are no belts or pulleys to change in such a move, and the eccentric adjustment can be made in seconds.

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Spiramatic Jigmil weighing 37 tons brought out by the DeVlieg Machine Co.



DeVlieg Spiramatic Jigmil

A 37-ton horizontal boring machine called a 5H-144 Spiramatic Jigmil is announced by the DeVlieg Machine Co., Royal Oak, Mich. This machine is part of the H series, features of which were introduced at the 1960 Machine Tool Exposition. The 5-inch spindle and huge size of this machine serve to increase substantially the range of precision boring, milling, drilling, and other machining operations that can be handled on DeVlieg Jigmil type equipment.

Repetitive precision capabilities of this machine are indicated by the accuracy and alignment of its tremendous 24-foot, 33,000-pound cast-iron bed. The bed has a basic

accuracy of 0.0001 inch per foot for straightness and alignment on all working surfaces. The vertical movement of the spindle head in the machine column is 6 feet; and its 50-inch wide table provides a 12-foot travel horizontally. Tables of the same width can be provided for 72-, 96-, or 120-inch horizontal travel. The machine is designed for advanced control systems and is readily adaptable to Diatrol, DeVlieg's dialing-in system of point-to-point dimensioning and positioning. This system allows preselecting coordinate dimensions for horizontal table movements and vertical action of the spindle head. The manufacturer's new numerical tape control system called Tapac, can also be used. In the latter, the master measuring-bar concept of the Diatrol system is employed for horizontal and vertical slide movements. Point-to-point measurement positioning of the horizontal and vertical slides is controlled by a standard 1-inch, eight-channel binary-coded punched paper or plastic tape. Direct power to the spindle is provided by a 20-hp motor, through the Spiramatic spindle head. The spindle-bar travel is 24 inches, and table retraction, 24 inches. Optional features include a thermal control system for the main spindle, a depth control attachment consisting of a rotating aluminum turret carrying twenty-four adjustable stops, and stainless-steel way covers.

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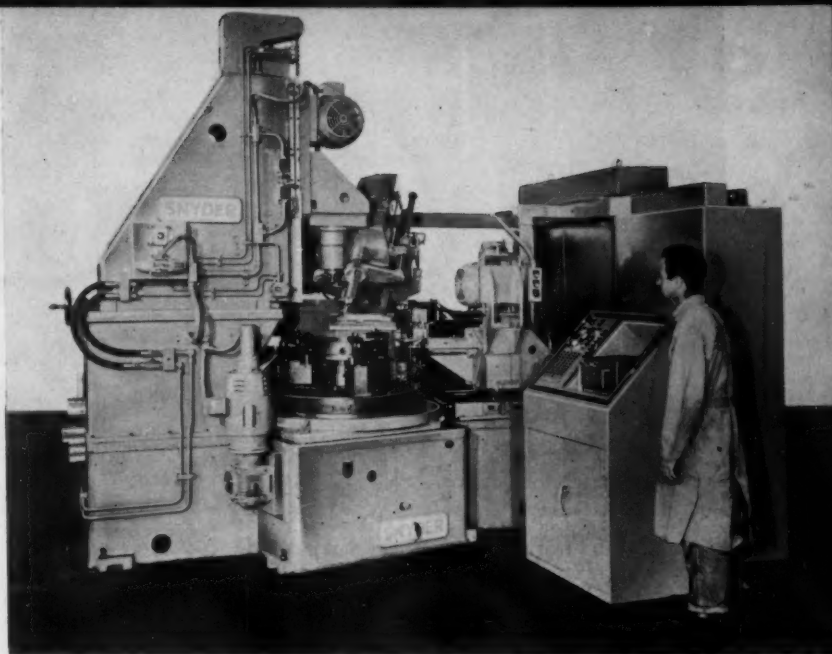


Fig. 1. Snyder numerically controlled, dial-index special machine set up to drill, counterbore, and ream a diesel-engine flywheel

Dial Type, Multiple-Head Special Machine Equipped with Numerical-Control System

What is believed to be the first application of a numerical-control system to a dial type, multiple-head special machine tool has been made by the Snyder Corporation, Detroit, Mich. In its first application, Fig. 1, the machine uses punched tape to drill, ream, and counterbore a variety of cast-iron diesel-engine flywheels, Fig. 2. It is designed to efficiently handle a wide variety of low-production metalworking machining jobs. Controlled by a General Electric Mark I numerical-control system,

the machine uses the punched tape to index the table and also initiate automatic feed cycles for the various machining units located around the periphery of the table.

An outstanding feature is the dial index-table, which operates at one of the highest speeds ever attained by any numerically controlled index-table. The 34-inch diameter table indexes at a rate of 2 rpm and maintains spacing accuracy of plus or minus 0.0005 inch on a 32-inch diameter.

In the diesel-engine flywheel application illustrated, the machine has one vertical, two horizontal, and one angular-mounted machining units. Currently the machine has process tapes for producing fifteen different flywheels ranging from 12 5/8 to 20 inches in diameter. Some flywheels require one or two machine setups, while others require three. The number of setups required is determined by the center-line heights of the various holes in the rim of the wheel. Basically the flywheels have holes to be drilled in three planes: the vertical, the horizontal, and an angular plane. The machine occupies a floor space of approximately 142 by 150 inches.

Circle 569 on Readers' Service Card

Fig. 2. Typical assortment of cast-iron diesel-engine flywheels processed on tape-controlled machine shown in Fig. 1



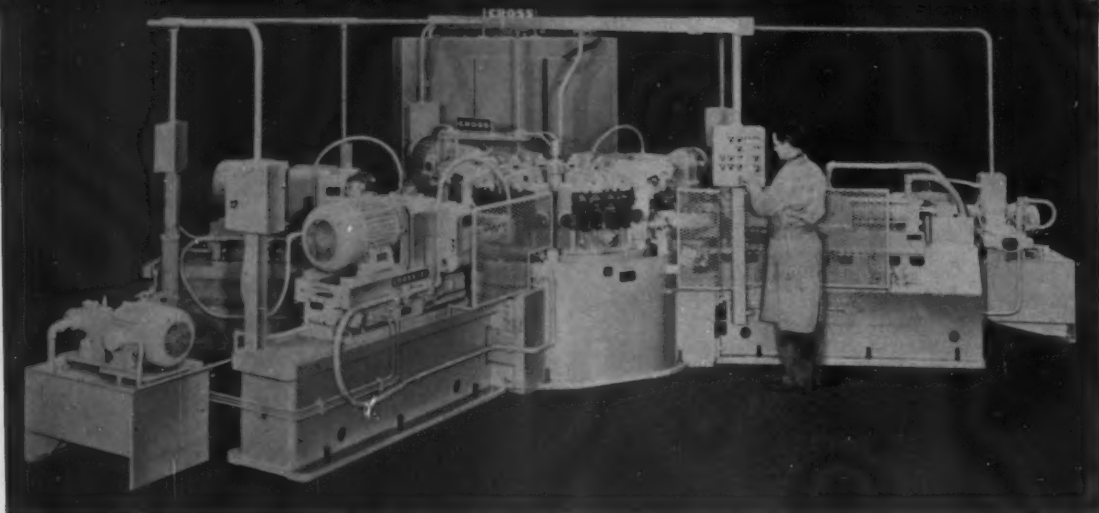


Fig. 1. Cross dial type machine that reduced cost of connecting-rods by including broaching operations

Cross Dial Type Machine for Processing Wrist-Pin Holes in Connecting-Rods

By combining strip broaching with drilling and chamfering on a six-station dial type machine, The Cross Company, Detroit, Mich., has made possible a considerable reduction in the cost of connecting-rods. Over 500 connecting-rods per hour are produced at 80 per cent efficiency on this machine, Fig. 1. The wrist-pin holes are completely finished, ready for bushing assembly. Although the forged steel connecting-rods have hardnesses ranging between 197 and 241 Brinell, the finished hole tolerance of plus or minus 0.0007 inch is easily maintained.

At the loading station, the operator places four connecting-rods in a fixture, Fig. 2, and actuates the hydraulic clamping mecha-

nism. Wrist-pin holes are drilled to half-depth in the first machining station. They are drilled through with a slightly smaller drill in the next station. With the majority of the stock removed, holes are core-drilled in the succeeding station, leaving only enough stock for broaching. Station 5 is tooled with automatic recessing tool-holders and formed bits to chamfer both sides of the drilled holes simultaneously.

In the last station, Fig. 1, each broach is centered individually by a pilot on its front end as it enters the work-piece. Coolant connection is established before the broaching stroke starts. As the broaches are pushed forward at the rate of 30 fpm, roughing and

finishing teeth take their cuts. The finishing teeth are followed by two ball burnishers—for which 0.0003 inch of stock has been left. After the burnishers pass through the hole, a rear pilot on the broach enters it to prevent the broach from dropping as it starts its withdrawal stroke. While the ball burnishers are provided to refine the finish of the hole, they also slightly enlarge it, which prevents drag on the cutting teeth during withdrawal.

The productive life of this particular machine is expected to be long because fixture nests are replaceable and can easily be changed to suit connecting-rods of different designs. Critical wear surfaces are replaceable carbide.

Fig. 2. Work-pieces are held in fixtures on machine shown in Fig. 1 by self-equalizing clamps

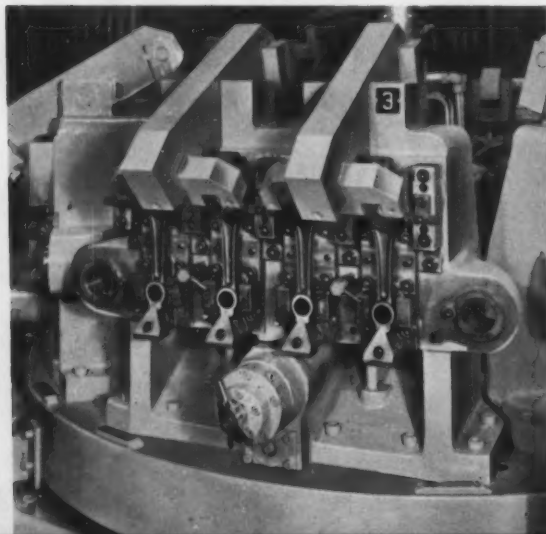
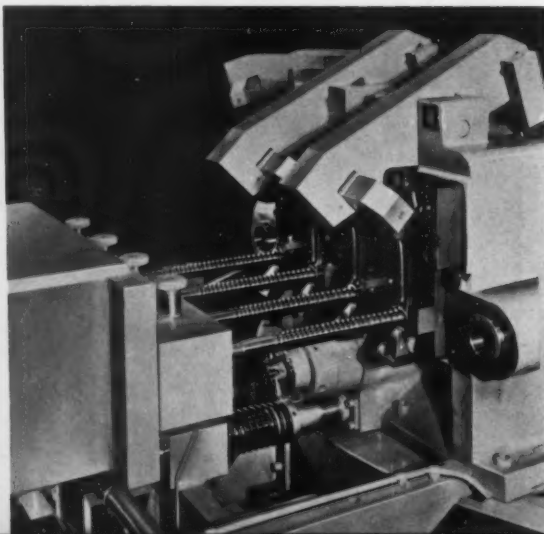
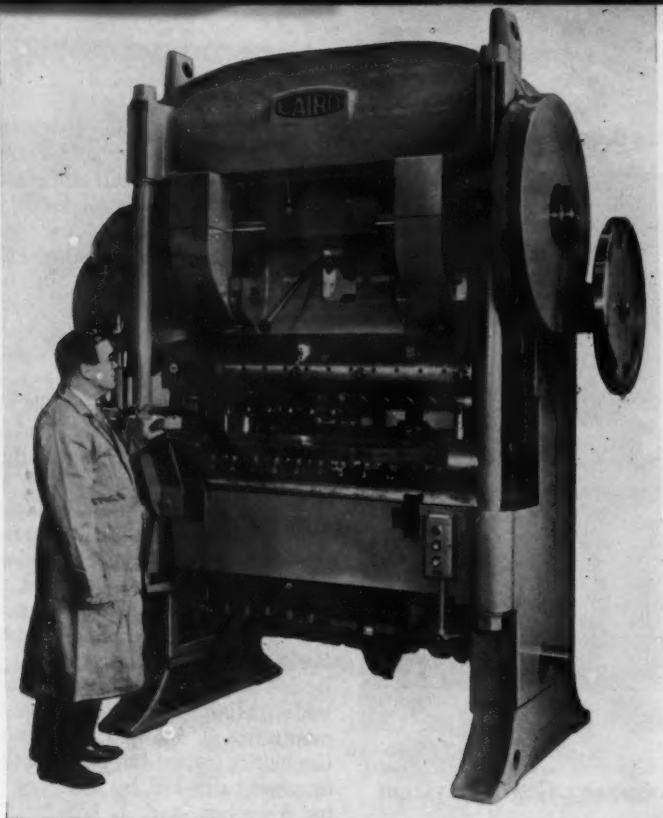


Fig. 3. Last station of Cross machine, Fig. 1, in which broaching operation is performed





Baird transfer press for high production of deep-drawn parts

Baird Transfer Press for Deep-Drawn Parts

A long stroke which permits high production of deep-drawn parts such as pen caps, lipstick cases, and electronic tube covers is a dominant design feature of the Model 5L transfer press recently introduced by the Baird Machine Co., Stratford, Conn. With a rated working pressure of 40 tons and a standard ram stroke of 7 inches, this transfer press offers a maximum depth of draw up to 3 inches and a working die space of 51 square inches. This provides for the production of deep-drawn brass parts at rates up to ninety per minute.

Production rates obtainable with the use of other metals is wholly dependent upon the metallurgical limitations of the material and the type and variety of operations performed. The Model 5L Baird transfer press offers the choice of nine-, ten-, eleven-, twelve-, or fourteen-station die sets. The maximum blank diameter of the nine-station die set is 3 1/2 inches, while the maximum blank diameter of the fourteen-station die set is 2 1/4 inches for a transfer stroke up to 5 1/2 inches.

Circle 571 on Readers' Service Card

of plus or minus 0.000050 inch. Numerically controlled by punched tape, the table is positioned hydraulically. An outboard support adds to the rigidity of the entire unit.

Circle 570 on Readers' Service Card

Tape-Controlled Boring and Drilling Machine

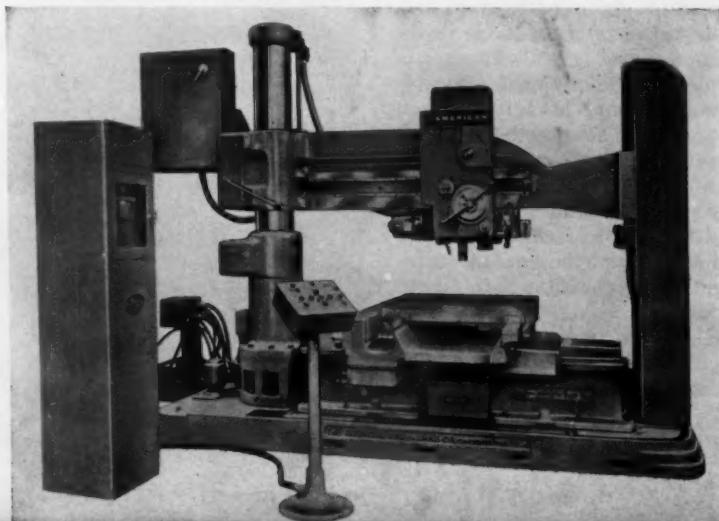
The American Tool Works Co., Cincinnati, Ohio, has introduced a package arrangement that includes an 11-inch column boring and drilling machine combined with a numerically controlled ultraprecision positioning table. Called the 511-12 semiautomatic precision boring, drilling, reaming, and tapping machine, this unit includes a tape-controlled automatic spindle cycle, formerly special but now standard equipment. After the dials are manually set, controls on the unit automatically traverse the spindle to the work-piece, feed it to a pre-selected depth, then traverse it back to the starting point. This cycle continues automatically until a tool change becomes necessary.

The spindle and sleeve are of the precision boring mill type, of nitrided Nitralloy steel honed to a 0.0002-inch sliding fit. Drive to the spindle, which is mounted on opposed precision Timken bearings, is through double keys in the sleeve. Spindle travel is 12 inches, while the maximum distance of the spindle to the table top is

37 3/4 inches.

There are twelve power feeds ranging from 0.001 to 0.025 ipr. Twelve spindle speeds are provided with a choice of three ranges, including 30 to 1500 rpm, 45 to 2250 rpm, and 60 to 3000 rpm. The main drive motor is 7 1/2 hp. The ultraprecision positioning table travels 30 inches on each axis, and has a positioning accuracy of plus or minus 0.00025 inch, with repeatability accuracy

Package arrangement of tape-controlled boring and drilling machine with numerical-control positioning table announced by American Tool Works Co.



Wallace Roll Type Pipe- and Bar-Bending Machine



Roll type pipe- and bar-bending machine built by Wallace Supplies Mfg. Co.

"Quick Change" Holder and "Micro-Set" Gaging System for Strippit Fabricators

Wales Strippit Inc., Akron, N. Y., has announced the development of a new gaging system for all its Model 15A, 10AA, and 10A fabricators. The Strippit fabricator shown in the illustration, equipped with the new holder and gaging system, is an extremely versatile single-station, high-speed punch press capable of punching round and shaped holes; notching corners, radii, and vees; and nibbling straight-line or contour patterns.

The new gaging system consists of a 1 1/4-inch "Quick Change" holder with "Micro-Set" gaging unit that allows the operator to make back- and end-gage settings directly to thousandths of an inch in a matter of seconds. Such fast and accurate gage settings are made possible by dial indicator assemblies and Microbars which are mounted directly to the holder base and the back-gage bar. Using only a chart of X and Y coordinates, the operator positions the dial indicator assembly to the nearest inch of the final measurement along the Microbar. Then, by moving either the back-gage or the work stops along the end gage into contact with the dial indicator carriage, the operator can

read directly to the required thousandth on the face of the indicator. Spring-loaded indicator carriage and plunger provide sensitivity and "feel" in gage settings and virtually eliminate any possibility of error, since the least variation is immediately evident on the face of the dial—and corrected.

An important feature of the new 1 1/4-inch Quick Change holder—an integral part of the new system—is an indexed guide and die bushing that permits shaped punches and dies to be rotated to any desired degree location in relation to the work-piece edge.

Circle 572 on Readers' Service Card

A new line of No. 460 series rolling machines that can be operated either right or left and which is capable of doing all kinds of pipe, tube, round-bar, square-bar, and flat bar bending has been announced by the Wallace Supplies Mfg. Co., Chicago, Ill. Tight coils, loose coils, flat spiral coils, wide radius bends, or short radius bends all can be done on these machines. One set of pipe rolls per pipe size is said to be equivalent to dozens of sets of fixed radius dies.

The Nos. 462, 464, and 466 machines have maximum capacities for cold bending to minimum radius bends 2-, 4-, and 6-inch pipe, respectively. Their respective tube (steel) bending capacities are 2 3/8 by 1/8 inch, 4 1/2 by 1/4 inch, and 6 1/2 by 1/4 inch wide. Minimum radius adjustments are 9, 18, and 36 inches. Capacities for flat-bar bending the easy way are 1/2 by 4 inches, 1 by 8 inches, and 1 1/2 by 10 inches. For bending flat bars the hard way, the capacities are 1/4 inch by 4 inches, 1/2 inch by 6 inches, and 3/4 inch by 6 inches. Round-bar bending capacities are 1 1/2, 3, and 4 inches; and square-bar capacities, 1 1/4, 2 1/2, and 3 1/2 inches.

Diameters of the rolls are 8, 12, and 18 inches, respectively. Roll speeds are 3, 2, and 1/2 rpm. Motors for operating the rolls are 3, 7 1/2, and 15 hp. The approximate floor spaces occupied by the machines are 3 by 5 feet, 8 by 7 feet, and 9 by 12 feet. These machines have net weights of approximately 3200, 7800, and 10,500 pounds.

Circle 573 on Readers' Service Card

Model 15A Strippit fabricator with Quick Change holder and gaging system



Sheffield Gage Measures Extremely Small Holes

An all-electronic inspection instrument capable of measuring a hole only 0.010 inch in diameter for size, taper, and bellmouth was one of several new and improved precision measuring instruments and equipment demonstrated at the recent ASTME exhibition in New York City by the Sheffield Corporation, Dayton, Ohio, a subsidiary of Bendix Corporation. Ten thousandths of an inch is approximately one-quarter the diameter of a typewritten period or about twice as thick as common sewing thread. The new instrument makes it possible to measure holes twice as small as previously possible on a production basis.

This Stereopoint gage, with its single gaging stylus and electromagnetic sensing, will be used to measure holes and other types of cavities and configurations in precision parts, miniature-size bearings, missile and servo-valve components, and similar high-accuracy parts. The instrument is an exclusive Sheffield development and is believed to be the first instrument yet manufactured capable of checking holes of this size.

Circle 574 on Readers' Service Card

(Below) Checking size of 0.010-inch hole on Sheffield Stereopoint gage



Magnetic Sheet-Metal Work Support for Power Squaring Shears

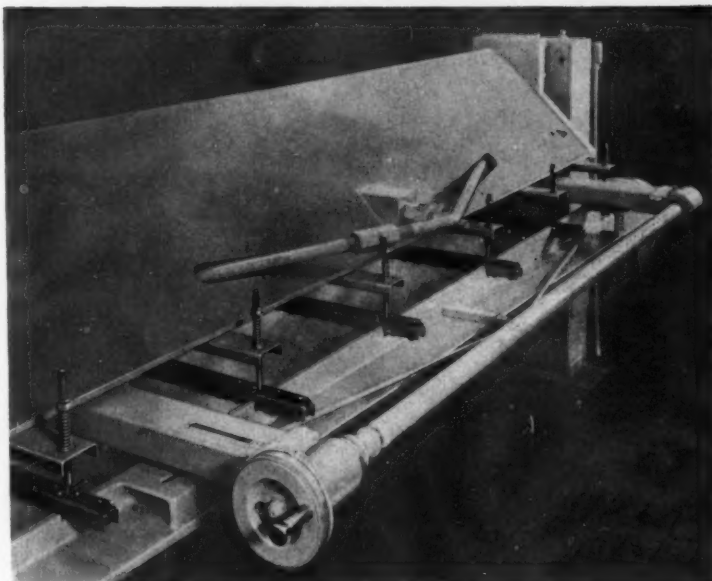


Fig. 1. Overhead view of Niagara magnetic sheet support installed on underdrive shear

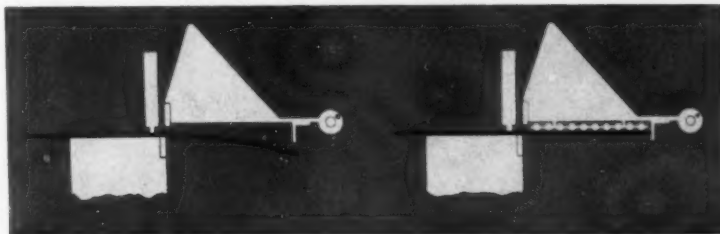


Fig. 2. (Left) Without magnetic support flexible sheets may drop and miss back-gage. (right) Niagara sheet support holds ferrous sheets level for accurate gaging

Wide, thin, flexible sheets can now be accurately gaged on Niagara power squaring shears, Fig. 1, by using a new magnetic sheet support just introduced by the Niagara Machine & Tool Works, Buffalo, N. Y. Designed for use with ferrous materials in thicknesses up to 16 gage, the support consists of several sets of magnetized rollers attached to the cross-head of the squaring shear. These rollers grip the material and hold it level, as shown in the view at the right in Fig. 2, to prevent drooping as the sheet passes from the rear of the bed to the back-gage. The holding power of the magnetized rollers is just enough to support the sheet until it is cut. Then the severed portion falls free instantly.

Circle 575 on Readers' Service Card



Wilson Specialty reports longer tool life, with Gulfcut® Heavy Duty Soluble Oil...

It's no easy task to machine an actuator support fitting assembly for a B-58 supersonic jet bomber. This calls for a company with a first-rate reputation in tough, complex machining jobs. The Wilson Specialty Manufacturing Company, Fort Worth, Texas, is such a company!

"Quite often, we find ourselves working with Titanium alloy and VascoJet 1000—two expensive ma-

terials," says Roy Watson, President. "And naturally, we've got to have a coolant which removes heat swiftly and gives us good tool life and a fine finish.

"Needless to say, we're fussy about cutting oils. In fact, we tried more than 8 different coolants before we settled on Gulfcut Heavy Duty Soluble Oil.

"We've found that a mixture of 20 parts water to one part oil provides effective cooling and lubricity



End milling Titanium alloy on a 3-dimensional Hydro-Version Arrow Profiler. The part is an actuator support fitting assembly for a B-58 jet bomber. The coolant is Gulfcut Heavy Duty Soluble Oil.



Roy S. Watson, right, President of Wilson Specialty, shows Frank P. Mauro, Gulf Sales Engineer, a Titanium part. Wilson Specialty tried 8 cutting oils—found Gulfcut Heavy Duty Soluble Oil to be the best!

◀ Milling groove in B-58 actuator support fitting assembly. Gulfcut Heavy Duty Soluble oil has improved tool life and increased feeds and speeds.

higher feeds and speeds GULF MAKES THINGS RUN BETTER!

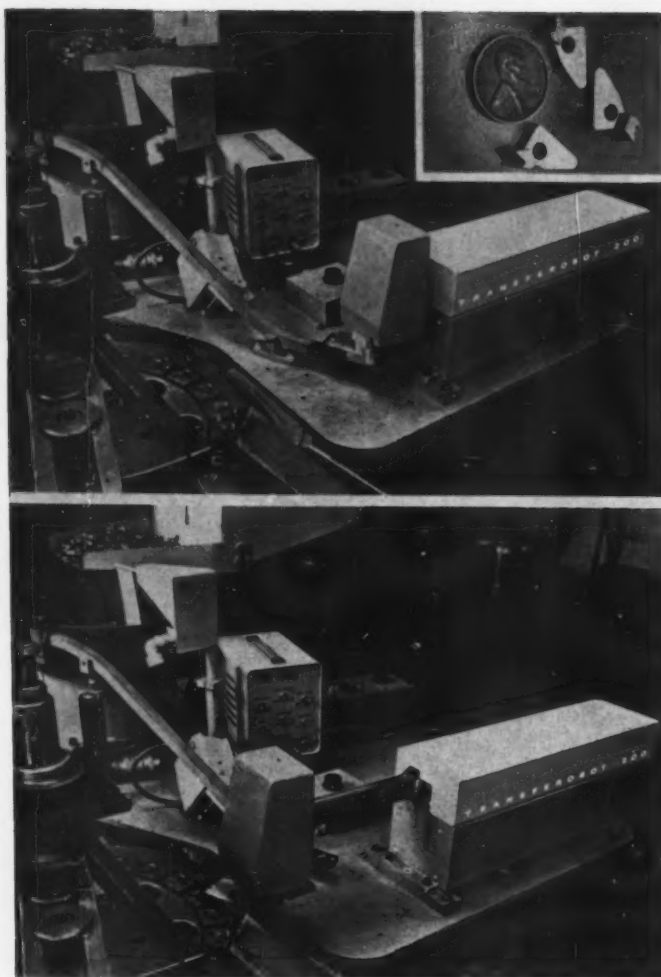
in our operations. Tools last longer. Feeds and speeds are higher. And our rejection rate is lower. Gulfcut Heavy Duty Soluble Oil deserves much of the credit."

If you're faced with a stubborn machining problem, give us the opportunity to show you how Gulf makes things run better! Call a Gulf Sales Engineer at your nearest Gulf office. Or write for Gulfcut literature.

GULF OIL CORPORATION
Dept. DM, Gulf Building
Houston 2, Texas



SP — 10106



TransfeRobot brought out by U. S. Industries, Inc., shown in pickup and delivery positions in handling typewriter part

TransfeRobot has Versatile Role in Automation Work

U. S. Industries, Inc., New York City, has introduced a new low-cost industrial robot designed to work on any assembly line under the command of its own electronic brain. Called TransfeRobot 200, this highly versatile device is now in production and is already being used by a number of large companies manufacturing such varied products as clocks, business machines, razors, and automotive and electrical equipment. It is capable of performing thousands of tasks in assembly and related operations, and is said to be the first general-purpose automation machine to be made available to

manufacturers as standard off-the-shelf equipment.

The following typical applications of the machine indicate its adaptability to a wide range of automation projects. The Westclox Co.'s plant in LaSalle, Ill., employs the TransfeRobot 200 to oil a complete clock assembly as it passes on a conveyor belt. In this installation the machine oils eight precision bearings simultaneously in one second.

At the Underwood-Olivetti typewriter plant in Hartford, Conn., the TransfeRobot 200 shown in the illustration picks up, transfers, and places a small type-

writer component into a close fitting nest for an automatic machining operation. The upper view shows how the device picks up an electric typewriter component (shown in inset) as it is delivered down a chute from the feeder. The bottom view shows how the part is transferred into the nest of an automatic countersinking machine. In this transfer operation the TransfeRobot's arm extends and turns as it carries the part from the chute to the machine tool.

In the manufacture of an automobile steering assembly, the TransfeRobot 200 feeds partially fabricated parts to a trimming press, orders the press to cut off excess material, and ensures that the finished parts are properly discharged from the press. The versatility of this device in plant operation stems from the fact that it can be programmed to do so many tasks merely by changing the accessories, somewhat as they are changed on a turret lathe. The device consists of an arm and an actuator which can be fitted with many types of fingers and jaws, all under the control of a self-contained electronic brain. With accessory jaws, positioning heads, and feeders, and with some simple cam adjustments, the TransfeRobot can be easily adapted at low cost to a wide variety of production jobs. Its fingers can seize, move, position, and relinquish the work-piece it is handling. With the use of an accessory swivel, the device also acquires a "wrist" movement which enables it to perform virtually any required set of motions within the limits of its reach.

Upon command of its electronic brain, the machine performs its own task and orders other machines (including other TransfeRobots) to act as well. It is thus in constant communication with the rest of the production line.

If the brain informs TransfeRobot 200 that something has gone wrong in the work program, the machine stops and the supervisor is told, through flashing lights or buzzers, to locate and correct the error.

Circle 576 on Readers' Service Card

SPRING DESIGN DATA—7

Torsion Springs—Load Deflection Characteristics, Free Angle Variation, and Length Variation

Load Deflection Characteristics

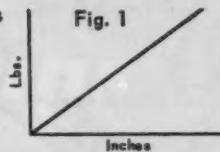
As mentioned in July Data Sheet 1 of Spring Design Data, helical torsion springs store energy by being twisted around the axis of winding. When permitted to release this energy, they tend to unwind and exert a torque, or moment, (M). This torque can be expressed in inches-pounds or in inches-ounces. Since one set of standards must be set to establish basic formulae for calculations, formulae are based on inches-pounds. Similarly, we have selected degrees rather than turns as the measurement of deflection (F), or spring motion.

The relation of the load to the deflection of the torsion spring, the spring "gradient" (K), is expressed in terms of inches-pounds per degree of motion and can be plotted, and graphically illustrated, by the sloping straight line in Fig. 1. The slope of line K can be calculated when certain dimensions of the spring are known and used.

A torsion spring must always have some type of a hook or arm at each end. These arms provide a means of loading or deflecting the spring. There are no "standard" ends as such and a detailed drawing should be supplied when ordering torsion springs. For some of the many types of torsion spring arms which can be formed automatically, refer to Oct. Data Sheet 8 of Spring Design Data.

When no load is applied to a torsion spring, the spring does not deflect, stores no energy, and is inoperative. In this inoperative position, the angle between the arms of the spring is called the "free angle" (θ_f). When load is applied, the "initial angle" of the arms is represented by θ_1 and the final angle by θ_2 . The initial angular deflection is represented by ϕ_1 and the final angular deflection as ϕ_2 . All of these are expressed in terms of degrees.

The only limit in the maximum deflection of a torsion spring is the point beyond which the spring cannot be deflected without becoming permanently deformed.



Free Angle Variation

In manufacturing a torsion spring, a piece of hard, or spring tempered, wire is wound on a mandrel of selected size. When this spring wire is released from the tight-wound position, the diameters of the coils increase slightly due to what is known as "spring back" of the wire. Spring back is caused by variance in the physical properties of the wire and, because spring wire materials vary, the spring back will also vary from piece to piece. Since it can be assumed that the length of the wire will always be the same, spring back variation will result in a variation in the relative position of the two torsion spring arms. This variation in the position of the arms is termed "free angle variation" ($\Delta\theta_f$).

The nomograph, Fig. 2, can be used to determine standard free angle variation. The variation obtained from the nomograph can then be used to predict the torque variation at the deflected position. This nomograph resulted from a research program which involved a study of commercial spring wire variation and production capabilities and covers the average case. To use, merely draw a straight line from the number of active coils (N line) to the numerical value of the spring index (D/d line) and read the free angle variation, in degrees, on the line $\Delta\theta_f$ as shown by the key.

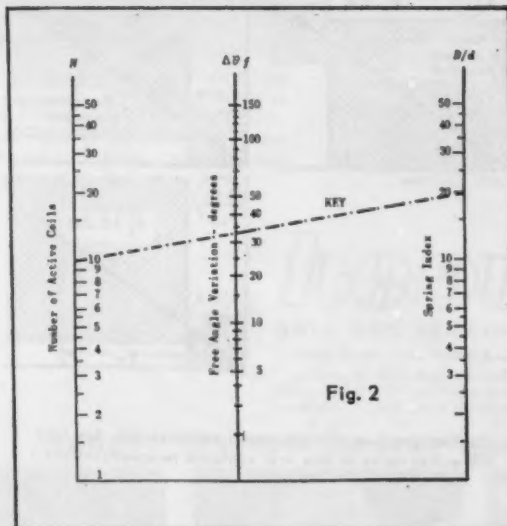
In some cases where quantities justify it and where tolerances must be held, the manufacturer can usually segregate and match wire and tooling to decrease the tolerances shown on the nomograph. In other instances, however, special manufacturing operations might be necessary to reduce the free angle variation to the tolerances required. In instances where tolerances lower than those shown on the nomograph are required, the manufacturer should be consulted.

There is also a variation in the gradient of springs in a lot caused by a slight variation in the wire diameter. The spring manufacturer cannot make changes in other dimensions to center the value of the gradient. A tolerance on either free position of arms or torque at a loaded position should be specified, but not both. If a particular torque at an angular position desired is specified but not the free position of the arms, the spring manufacturer can compensate for the small gradient variation by varying the free position of the arms. The tolerance (free angle variation) would then apply to the corrected angle for the purpose of predicting torque variation.

Length Variation

Like all measurements in any manufactured product, the length of a torsion spring will vary. If the spring is a close-wound torsion spring, the variation in length could only be due to variation in the wire diameter. This variation is extremely small and very seldom causes difficulty in application. On the other hand, in an open-wound torsion spring, the length variation will be much greater than that of a close-wound spring due to the variation in the pitch of the open-wound coils.

Since the length variation will not effect the torque load, but only the way the spring fits in application, the designer should have no difficulty in allowing whatever tolerance is needed to compensate for this slight variation. In most applications, the end thrust, resulting from a slight compression of an open-wound torsion spring which varies in the long direction, is more desirable than the friction between the coils if the spring were made close-wound.



MACHINERY'S DATA SHEET

SPRING DESIGN DATA—8

Simple, Close-Wound Torsion Springs—the Six Ways to Specify

The first action to take when starting close-wound torsion spring specification or design is to determine which torque (M), the initial torque (M_1) or the final torque (M_2) is of greater importance in the particular application for which the spring is intended. When the most important of the two torques has been determined, it is then referred to as the "primary" torque and the other becomes the less important, or the "secondary" torque. In some instances, the initial torque may be determined to be most important, or primary, and the final torque less important, or secondary. In other applications, the reverse is the case — the final torque might be primary and the initial torque secondary.

After selecting a primary operating torque (M) at an angular deflection (ϕ), it is then necessary to establish a direction of spring action and fix a spring motion (ϕ_m) when the spring operates at more than one angle. This can be done in one of 6 ways as shown in the illustrations. Case I applies where final torque (M_2 at ϕ_2) is primary, and Case II where initial torque (M_1 at ϕ_1) is primary.

The torque-deflection characteristic of a simple close-wound torsion spring is fixed by the specification of primary torque at an angular deflection. The second torque is then determined by the direction and magnitude of spring motion (ϕ_m).

Frequently, only the final torque is important in specifying a spring. When this is so, other desirable characteristics (length, magnitude of spring motion) should be determined and should be made the second, required factor. This is illustrated in Case 1A.

Or, both the primary and the secondary torque may be specified directly with deflection and gradient fixed by this procedure as shown in Case 1B. However, the tolerances should not be made unduly restrictive as this could require the spring manufacturer to resort to additional testing and inspection and special manufacturing operations. This can be avoided by specifying only outside limits on torque (maximum final torque and minimum initial torque) as shown in Case 1C.

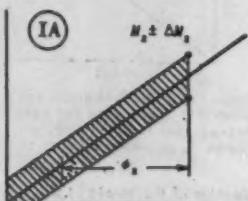
When the application requires the softest possible spring (the two torques as close together as possible), the gradient should be made as small as possible by basing the design upon using the largest possible coil diameter (D) and the largest number of active coils (N). This is illustrated in Cases 1G and 1IG.

In applications where primary torque and a specific additional deflection are required, it is well to design for minimum stress at the final deflection as shown in Case 1IS.

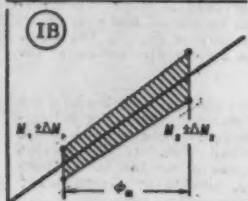
After the spring requirements have been placed in one of these 6 categories, the way will be paved for further design steps which follow.

Case I
Final Torque Primary

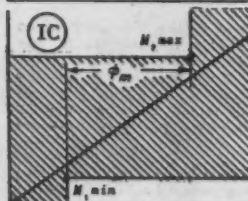
Case II
Initial Torque Primary



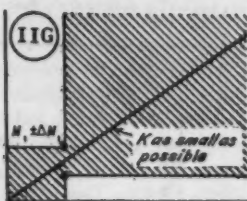
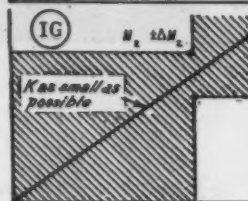
RARE



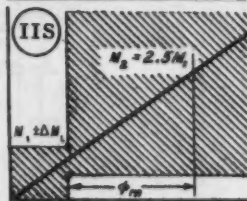
SAME AS 1B



SAME AS 1C



NONE

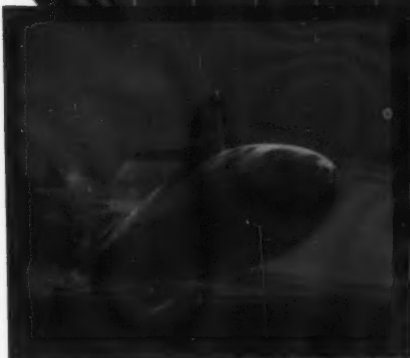


Sectioned-area represents normal variation (Δ). Any load deflection curve in this area conforms to specifications.)

Courtesy of Spring Division, Hunter Spring Co., Lansdale, Pa.

hoover quality bearings

... HARDLY A WHISPER



Nuclear submarines like the SKIPJACK are designed to carry out underwater missions in utmost silence. That is why the hushed quietness of *Hoover Quality* ball bearings makes them ideal for critical applications on this and many other types of equipment.

Hushed quietness in a bearing is a promise of excellent quality, superior performance and long life.

And it's no coincidence that Hoover bearings are exceptionally quiet. *Hoover Honed* bearing raceways are super smooth, superbly finished. *Micro-Velvet* balls are spherically accurate within millionths of an inch and surface finished to microscopic perfection. These precision components work together in perfect harmony. We, at Hoover, know because every *Hoover Quality* bearing is checked electronically before it is shipped.

Hoover Honed and Micro-Velvet are Hoover Trademarks

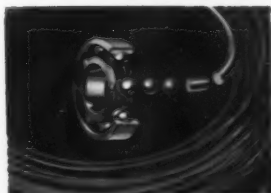
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hoover CONTROLS hoover quality FROM START TO FINISH



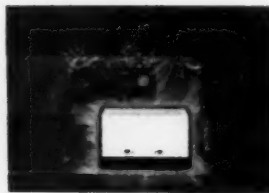
High quality wire from which balls are made is produced by Hoover's Cuyahoga Steel and Wire Division.



Hoover *Micro-Velvet* Balls are made of the finest of chrome alloy steel. Sphericity is measured in millionths of an inch.

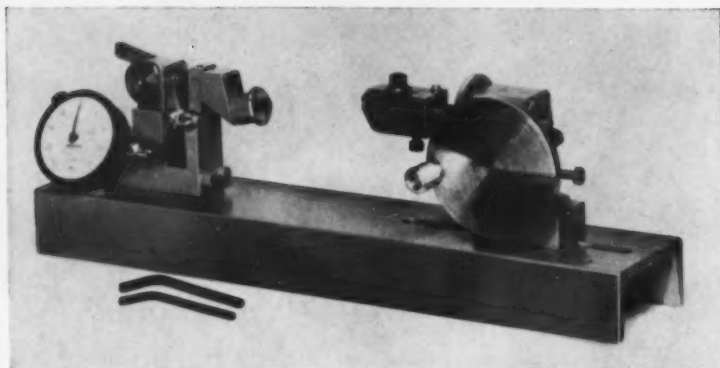


It's easier to strike a match on plate glass than on the smooth finish of a *Hoover Honed* bearing raceway.



Hoover quality control methods include non-destructive electronic inspection of bearing components.

Weld-Joint Tensile Testers Added to Electronic Welding Equipment



Hughes weld-joint tester developed for its electronic welding equipment

The addition of weld-joint tensile testers to its line of electronic welding equipment has been announced by the Vacuum Tube

Products Division of Hughes Aircraft Co., Oceanside, Calif. These portable units find application in the development of weld sched-

ules used in high-density electronic component packaging, as well as in statistical quality control of production welding. The units are available in two models: the VTA-46, having a testing range of 0 to 50 pounds; and the VTA-47, with a 0- to 100-pound range. Both models feature a load indicator which holds the maximum specimen pull until reset. A one-to-one mechanical adjustment of the load jaws makes possible quick setups, but actual loading is applied through a 100-to-1 ratio reduction wheel. Other features of the units, shown in the illustration, are a jeweled meter movement, interchangeable jaws, and antibacklash provisions to prevent surge readings at the breaking point.

Circle 577 on Readers' Service Card

Versatile Lead-screw Drilling and Tapping Machine

The Foote-Burt Co., Cleveland, Ohio, has announced a five-way, eighteen-spindle hydraulic-feed and lead-screw drilling machine with indexing table for processing automotive transmissions, front-extension housings, and similar high-production parts. This unit type machine has a massive cast-iron base which carries a five-position indexing table and five way units. The table has double fixtures for complete processing of ten parts simultaneously. A vertical thirteen-spindle head drills all axial holes in the housing. Two of these holes are tapped by a second vertical two-spindle tapping head. A third way unit drills one angular hole, and two horizontal drilling heads generate one hole each.

After parts are loaded and clamped manually, the machine indexes and completes the entire drilling and tapping cycle automatically. Parts are unclamped and unloaded manually. The machine finishes two complete parts at each index: forty-five parts per hour at 80 per cent efficiency.

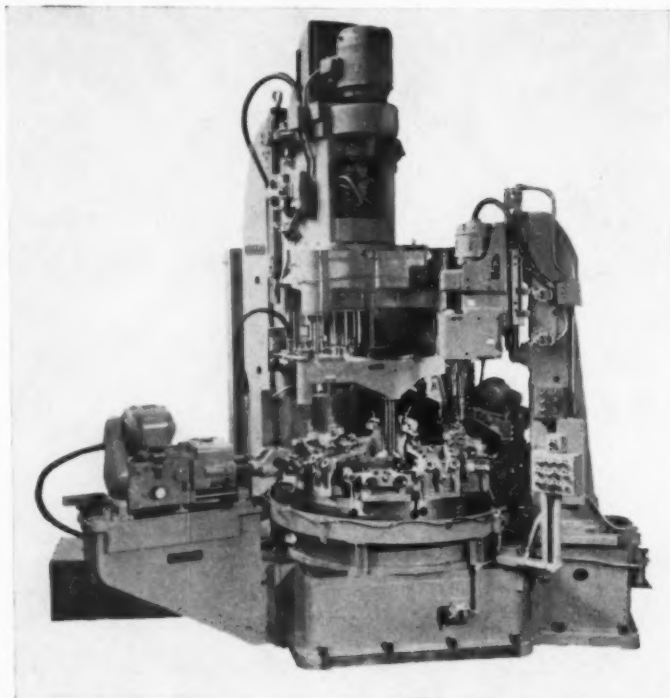
Vertical spindles have hydraulic feed and oil-mist lubrication. They are gear-driven from a splined shaft. Precision lead-screws provide accurately controlled feed for the angular and horizontal spindles. An oil-flow system lubricates

the lead-screws on these units. All spindle-carriers slide on Footburt round ways. Chips and dust cannot collect on these ways to destroy accuracy or jam the machine.

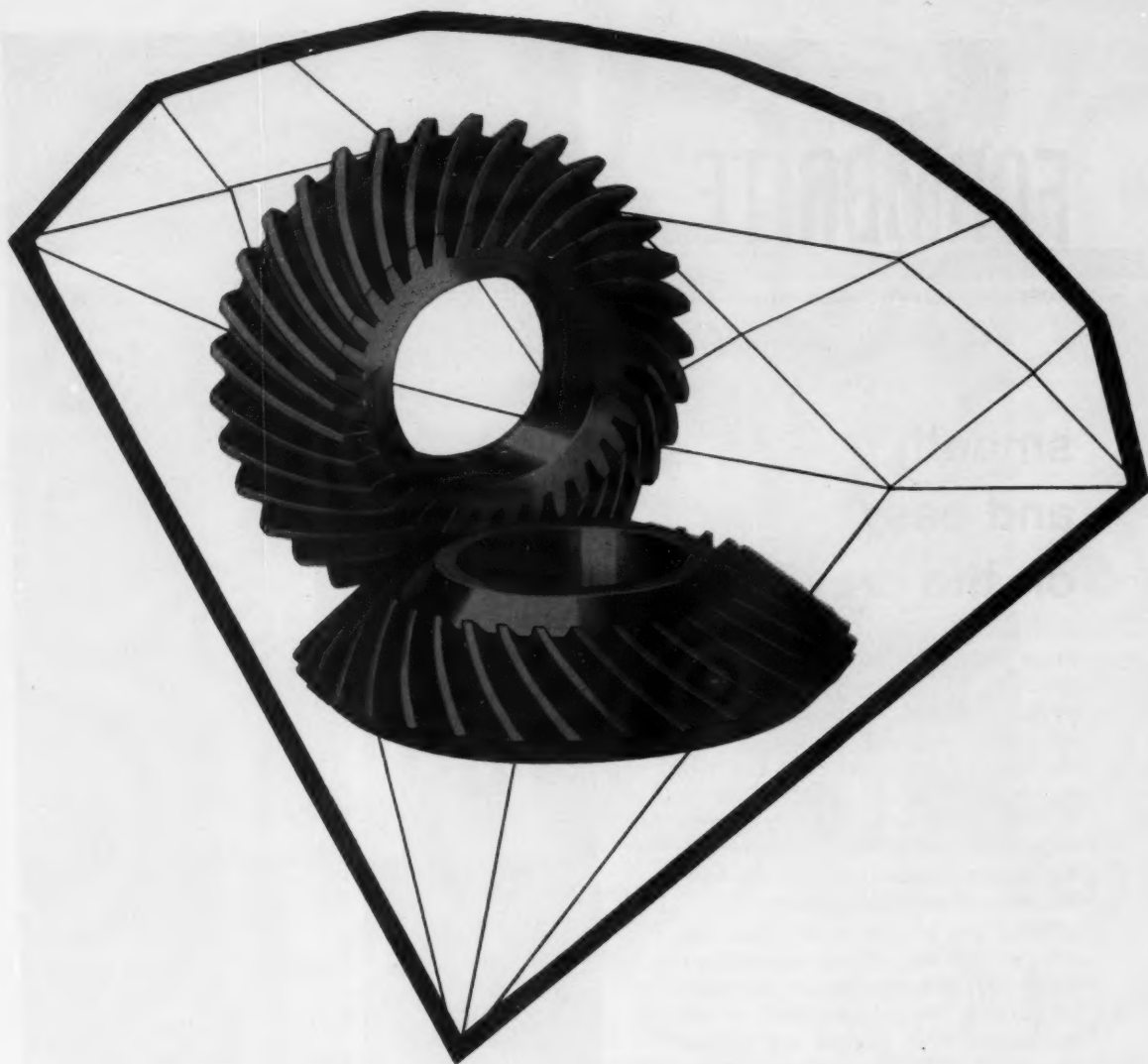
Multiple-position indexing machines of this type can be custom-

fabricated with almost any number of spindles. Horizontal milling, angular milling, or other special units can be built into any station. Pick-off gears for speed selection can be provided for all lead-screw units to accommodate changes in part design or production.

Circle 578 on Readers' Service Card



Footburt five-way multiple-spindle drilling and tapping machine



Flawless in every brilliant facet...

CINCINNATI

CUSTOM GEARS AND GEAR BOXES
achieve *uniformly top quality* in making your gearing designs precisely to your specifications.



Ask for this brochure—CINCINNATI custom gears are made in all types to 72" diameter cut teeth, 39" shaved teeth, 25" ground teeth.

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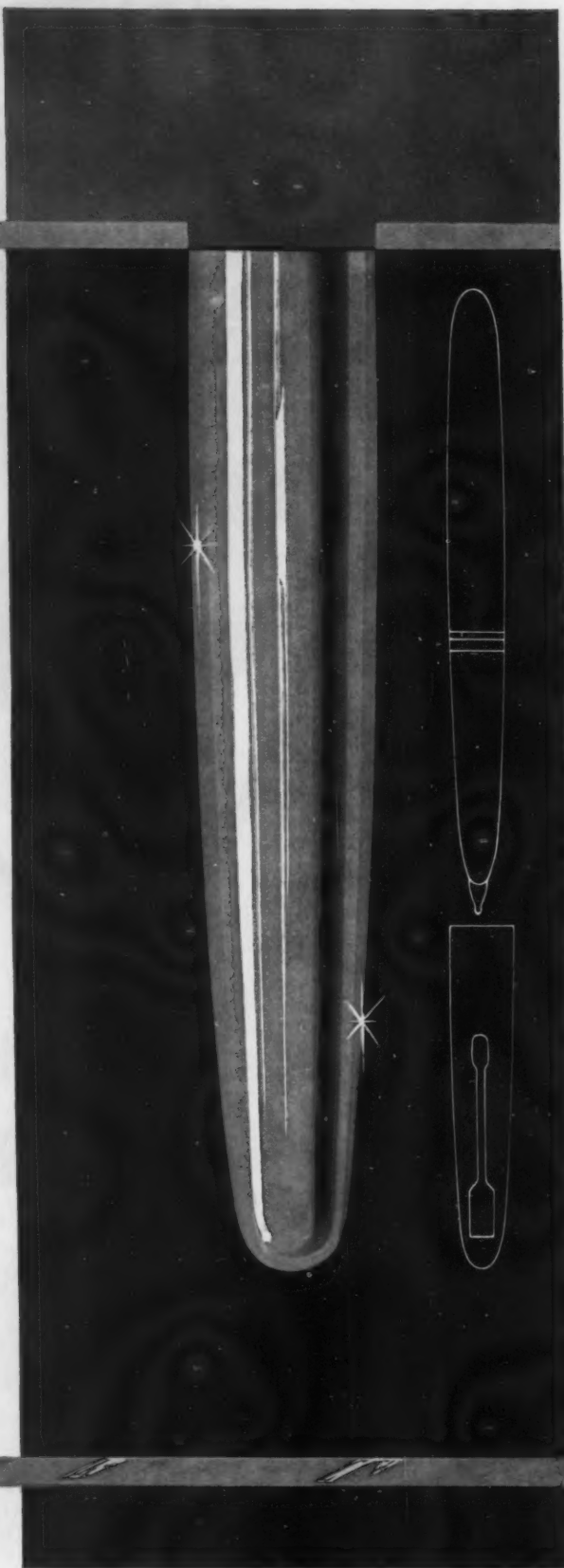
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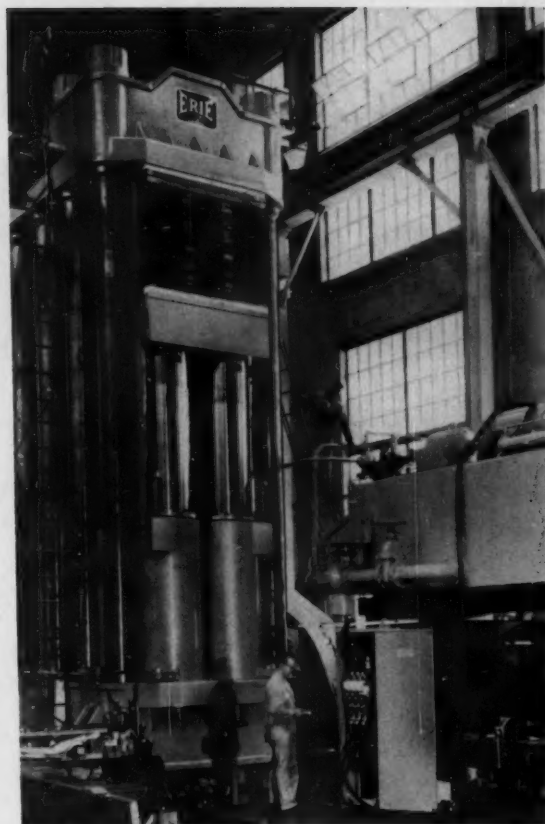
Giant-Size Hydraulic Press

A huge hydraulic press, said to be the largest of its type ever constructed in the United States, is undergoing exhaustive tests prior to shipment by its builder, Erie Foundry Co., Erie, Pa. Designed and built for the Micarta Division, Westinghouse Electric Corporation, Hampton, S. C., the machine is scheduled to produce decorative laminated boards for counter tops, panels, inlays, and other related applications. Completely automatic, it will load, process, and unload 250 boards in an hour.

The press stands 35 feet high, has sixteen openings, and will take a board 70 by 154 inches. It will be installed in a foundation pit 15 feet deep by 34 feet long, and will have a new building constructed around it. The press has eight high-pressure hydraulic cylinders and eight heavy strain rods.

Circle 579 on Readers' Service Card

Huge hydraulic press (right) of completely automatic type built by the Erie Foundry Co.



Three-Way Machine for Processing Cylinders in 90-Degree V Type Automotive Compressors

A three-way machine built by the Ex-Cell-O Corporation, Detroit, Mich., is being used with exceptionally good results for boring and chamfering the steel sleeves and facing the die-cast aluminum cylinder castings of a 90-degree V type compressor assembly, made by a well-known supplier of automotive parts.

Since the compressor cylinders are at 90-degree angles and the individual units of the way machine are assembled at 90-degree

angles, this arrangement permits machining both cylinders of two units simultaneously. Aluminum cylinder castings and SAE 1010 steel sleeves are machined with the same spindles in one cycle.

In operation, four boring spindles converge on the work-pieces and take a 0.060-inch finish cut in the cylinder liners. At the end of the stroke, a 30-degree chamfer is cut. Tool-slides of bridge type facing heads then move radially and generate a joint face in the

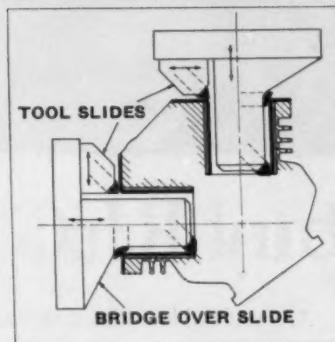
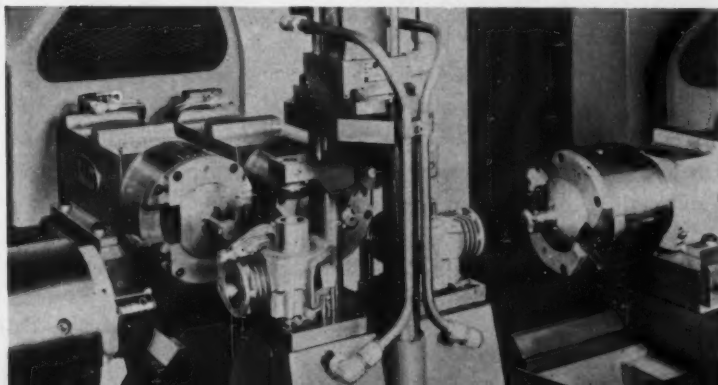


Fig. 2. Tool layout of machine in Fig. 1, with surfaces of part machined indicated by heavy lines

Fig. 1. Ex-Cell-O three-way precision boring machine equipped for processing compressor cylinders

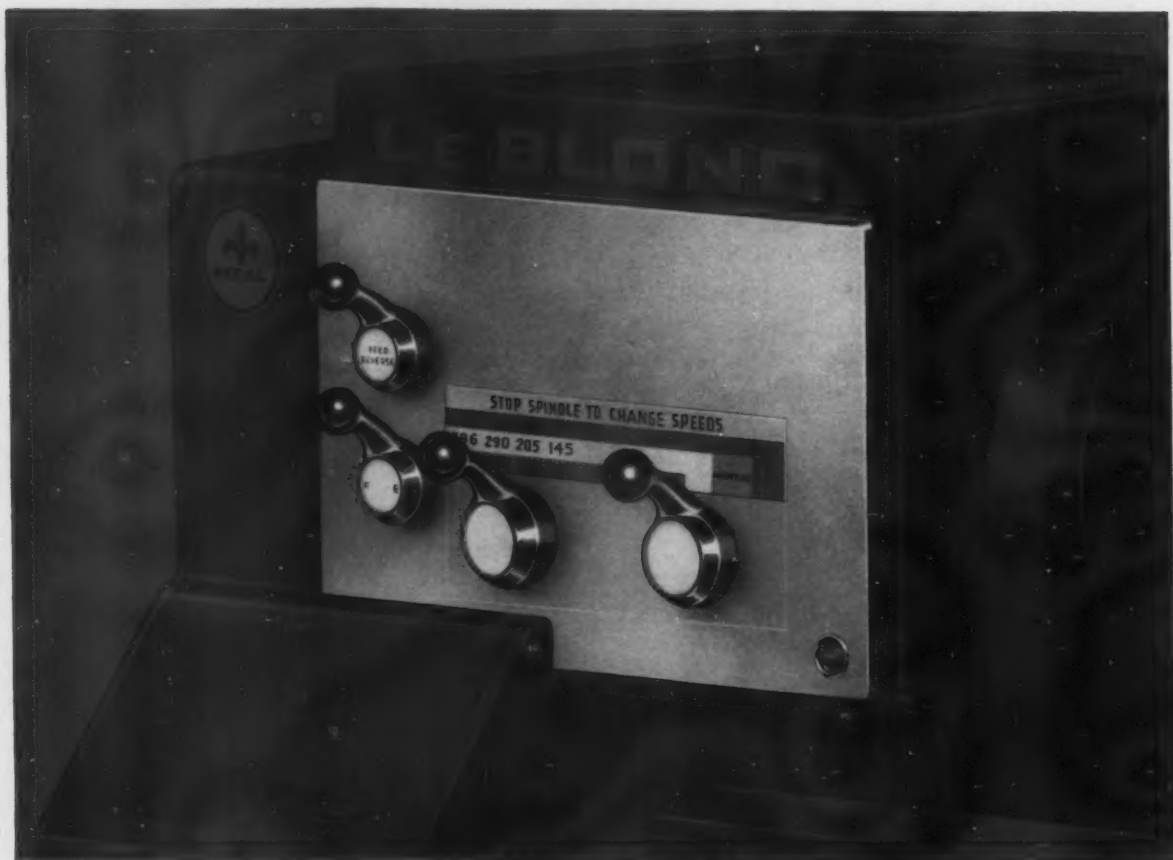


cylinder castings. Coolant is piped to the center of the work-pieces and carefully directed to each bore. Parts are manually loaded and hydraulically clamped.

Regardless of heavy stock removal from the bore, a good finish is produced ready for honing. The work is held within a tolerance of 0.001 inch. Gross production of 220 parts is attained, using two machines and one operator.

Circle 580 on Readers' Service Card

new concept in Lathes



buy REGAL with manual shift....

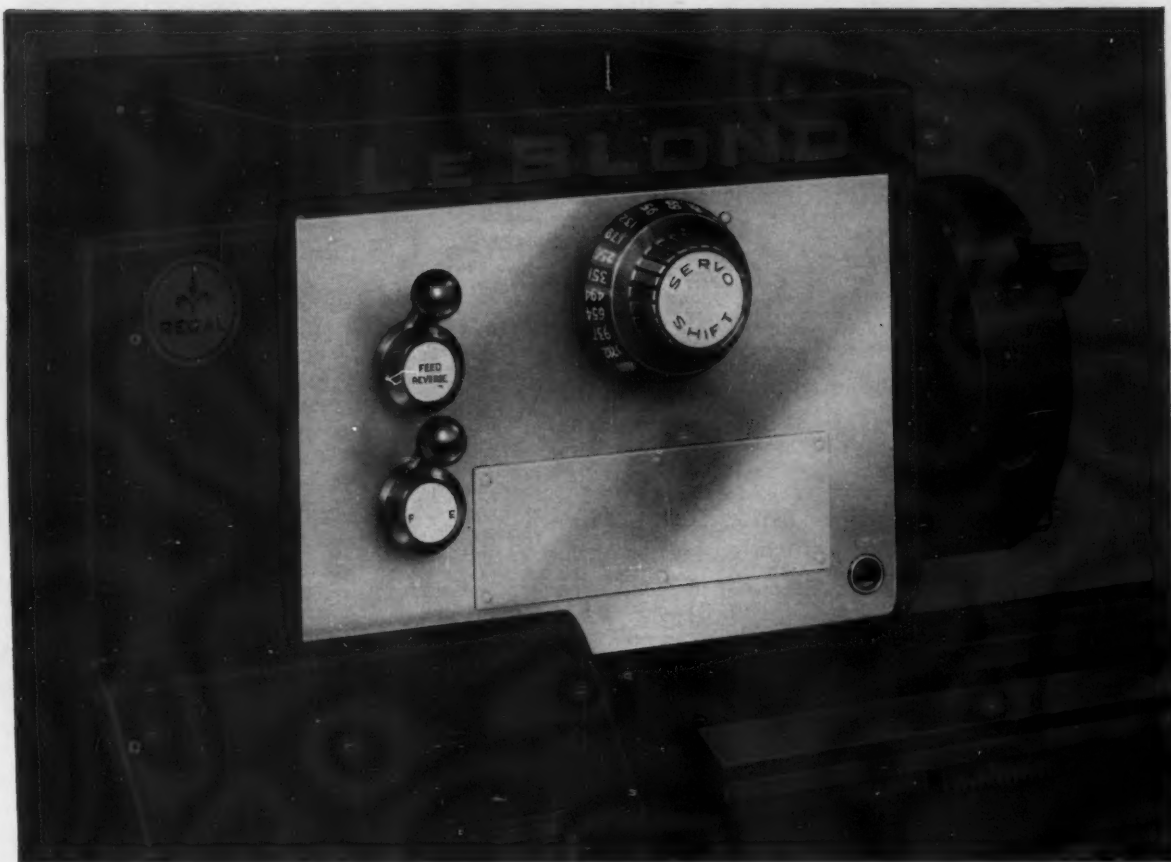
Are you dubious about the advantages of hydraulic shifting on small lathes? Ingenious design of the new LeBlond Regal headstock lets you start with manual controls and add hydraulics in your shop at any time in the future! It's like having your cake and eating it, too.

The cost of adding the Servo-Shift package in the field is modest — just slightly more than original factory installation.

Brand new Regal Servo-Shift makes speed changing faster and easier than ever before. You select your next spindle speed while still cutting.

Then move the control lever to brake position and get almost instantaneous automatic shifting—*with no clashing of gears!* This is the fastest and safest hydraulic shift available in a lathe today! It's simple and foolproof! It will make a hero out of every operator!

Our new Regal — the low-cost lathe with big-lathe features — has many more important advantages *not available in any other machine* of the same class. Ask us to have a LeBlond field engineer stop and tell you about them, or write for our new descriptive Bulletin R-961 H.



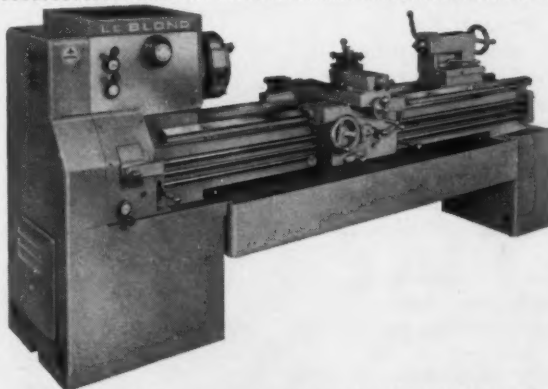
.....add **SERVO-SHIFT** later!

New LeBlond Regals are now available with 13", 15", 17" or 19" swing, and either manual or Servo-Shift.

*World's largest builder
of a complete line of lathes.*



The R. K. LeBLOND
MACHINE TOOL COMPANY
Cincinnati 8, Ohio





Six continuous-path tape-controlled lathes of first lot being run off the final stage of production line at the plant of the R. K. LeBlond Machine Tool Co.

LeBlond "Tape-Turn" Continuous-Path Tape-Controlled Lathes

Continuous-path tape-controlled lathes designed to turn complex contours, tapers, sharp angles, and radii, as well as take facing, plunge, and straight-turning cuts, are being built by the R. K. LeBlond Machine Tool Co., Cincinnati, Ohio. The illustration shows six "Tape-Turn" lathes being run off the production line with tests indicating precision alignments. These are 20-hp models in both 2013 and 2516 sizes. They are available with thirty or ninety spindle speeds ranging from 22 to 1000 rpm and motor-speed variations in 4-to-1 or 20-to-1 ratios.

Also being built with up to 75 hp in the 4025 size, these lathes are 100 per cent tape-commanded with all operator controls at the console. The General Electric Mark Century continuous-path control uses solid-state components (no tubes, stepping switches, or rotating parts). It is temperature and humidity controlled. A built-in computer for linear or circular interpolation provides for all standard types of cuts desired in lathe operation.

Three-, four-, or six-station turrets are completely interchangeable to allow for preset tooling. Twelve-position indexing of the turret provides for placement of

any tool for machining all types of work-pieces. Tool offset compensation on both axes in 0.0001-inch increments facilitates setup and compensation tool wear. Precision

ball-bearing feed-screws are used for both length and cross motion with accuracy resolution on the nonload end. Thread cutting is available as optional equipment by electrical integration of the spindle and feed-screw.

Circle 581 on Readers' Service Card

Brown & Sharpe "Thriftmite" Miniature End Mills

A line of precision-ground, miniature, high-speed-steel end mills is being introduced by the Brown & Sharpe Mfg. Co., Providence, R. I. All of these end mills have two or four flutes and 3/16-inch shanks. They are available in eight styles, including stub length, single- and double-end, and ball-end types. Sizes range from 1/32 to 3/16 inch in diameter.

These new miniature end mills

are recommended for plunge cutting, slotting, contour-cutting, profiling, and general-purpose end milling on virtually all materials. They are especially efficient for slotting or router type cutting of fiber sheets, laminates, and other thin synthetics or alloys used in electronics and circuit-board work. They are precision-ground with a 40-degree helical flute.

Circle 582 on Readers' Service Card

Thriftmite miniature end mills introduced by Brown & Sharpe Mfg. Co.



Snyder Corporation Applies Numerical Control to Dial Type Multi-Unit Machine



This new Snyder machine drills, reams and counterbores a wide variety of cast iron diesel fly-wheels by use of numerical controls. Fifteen different fly-wheels from 12½ inch to 20 inch diameter are processed with various control tapes. The wheel shown in the right foreground is unprocessed. Others are as they come from the machine, ready for assembly.

For the application illustrated, the machine

has one vertical, one angular and two horizontal standard units which are mounted around a 34 inch diameter table indexing at 2 rpm while maintaining an indexing spacing accuracy of plus or minus 0.0005 inches on a 32 inch diameter.

This type of machine is equally adaptable to a wide variety of other low production metal cutting work and its versatility, accuracy and economy suggest many profitable applications.

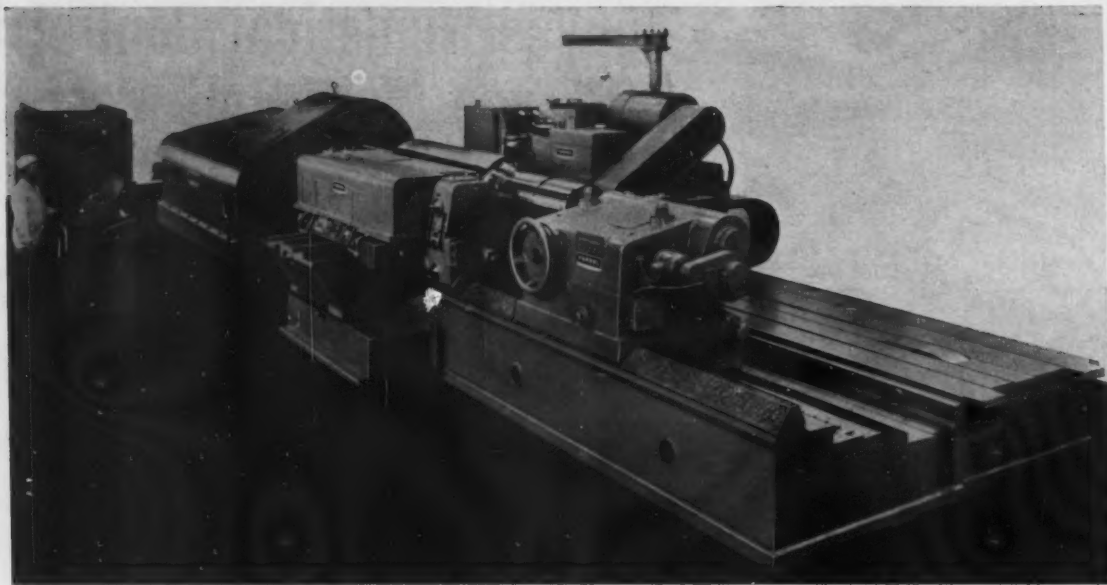
Movies of the machine in action are available.

We'll be glad to show them at your convenience. Just phone or write.

SNYDER CORPORATION

3400 E. LAFAYETTE—DETROIT 7, MICHIGAN

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Farrel 60-inch fully automated roll grinder with control console

Farrel-Birmingham Heavy-Duty Roll Grinder with General Electric Numerical Control

Complete automation of a 60-inch heavy-duty roll grinder under punched-tape control has been announced by the Farrel-Birmingham Co., Inc., and the General Electric Co. Just completed at the Farrel-Birmingham plant at Ansonia, Conn., the precision grinder will finish work rolls for metal rolling mills. It will automatically grind straight or crowned rolls up to 5 feet in diameter to exacting tolerances of diameter and straightness, and also duplicate diameters for pairs of work or backup rolls.

Special numerically addressed sequence and servo control for the grinder was developed by the General Electric Specialty Control Department, Waynesboro, Va. Similar in theory to the punched-tape numerical control used with modern machine tools for "flexible automation," the roll-grinder control uses servo-controlled positioning of probes to measure the diameter and profile of rolls being worked, and to detect uncompleted work.

Operating from standard 1-inch tape, the automatic control will direct the grinder through a complete cycle, performing all operations necessary to refinish a roll.

Once the operator starts the grinding wheel and pushes a "cycle start" button, the machine and control system, as programmed,

take over the work of rough grinding, aligning the work-piece, semi-finishing, dressing the grinding wheel, finish grinding, and finally measuring and recording a print-out of roll size.

Circle 583 on Readers' Service Card

Rheem Automatic Numerical Three-Axis Positioning Control

A new development in numerical-positioning controls that enables automatic control of three axes in a turret drill application has been announced by the Rheem Mfg. Co.'s Electronics Division,

Los Angeles, Calif. The Rheem M33 control, combined with a Burgmaster turret drill as shown in the illustration, provides tape control for a third, or vertical, axis. The Rheem M23 control, the first

Burgmaster turret drill equipped with Rheem numerical-positioning control

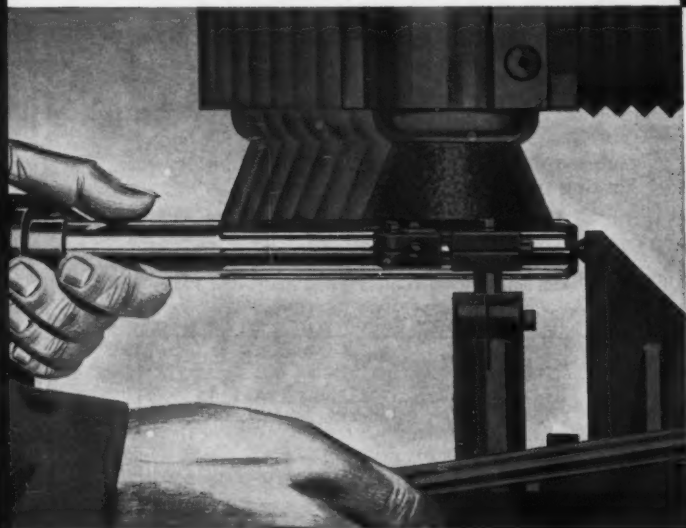


NOW FOR 1961

OLIVER OF ADRIAN "ACE" TOOL AND CUTTER GRINDER

The "ACE" tool and cutter grinder is a prime example of a simplified approach to a difficult problem. Face mills, reamers, end mills, staggered tooth cutters, slab mills, spot facers, etc.—straight or spiral—are quickly, easily and economically sharpened with the Oliver "ACE." It is extensively used, too, for sharpening carbide-tipped circular saws.

Cost savings are attractive with respect to both set-up and grinding time. Set-up usually consists of two simple "direct reading" adjustments. The work holding unit is set and the grinding wheel spindle is tilted to produce the proper clearance. It's that simple!



Traverses the wheel . . . not the work

You can grind tools and cutters faster with Oliver's "ACE" because the wheel is brought to the work, reversing the usual process. Normal maintenance due to abrasive matter is eliminated because the major moving parts are above the grinding area and are completely sealed. *Accuracy is assured because the wheel is trued by a stationary diamond which provides a fixed grinding line.* It is not necessary to compensate for wheel wear.

Designed specifically for the job

The numerous features of the "ACE" set it apart from a general purpose machine adapted to tool room work.

- Easy to set up. All angles are obtained by direct reading.
- Operator stands in a natural position with the control lever in easy reach and the work in direct view.
- Grinding time is reduced because it consists wholly of bringing the grinding wheel on and off the cutting tool—tool travel is eliminated in most cases.
- Special attachments, such as those used for radius work and for sharpening flat broaches, extend the machine's range of application.

Look to Oliver for the modern approach to your cutter grinding jobs. Write for complete information and quotations.

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DRILL GRINDERS AND THINNERS. AUTOMATIC AND MANUAL
FACE MILL GRINDERS. TOOL AND CUTTER GRINDERS. TOOL
BIT GRINDERS. CONTOUR SAWING AND FILING MACHINES.

model of which was shown recently at the ASTME exposition in New York, is combined with the Burgmaster turret drill to provide tape control for positioning a table in two axes—longitudinal and cross—and for operating the hydraulic turret drill to carry out a predetermined sequence of operations. These may include drilling, boring, tapping, reaming, counterboring, and spot facing to extremely close tolerances with the simplest of tooling.

A feature of the Rheem system is that special engineering drawings are not needed. Dimensional information from customary drawings is utilized in decimal form with a tape preparation unit. The data is read by a Rheem photocell reader. In the Rheem control system, each axis of control is a separate module, and any number of axes can be controlled simultaneously by adding axis modules. Other Rheem features include availability of different resolutions; high positioning speeds; feed-rate control, if desired; auxiliary functions; decimal display of tape information; and choice of automatic, semiautomatic, and manual modes of operation.

Circle 584 on Readers Service Card

Heald Tool-Tronic Tool-Setting Gage

The Heald Machine Co., Worcester, Mass., has announced a tool-setting gage designated the Tool-Tronic. It is a combination optical and electronic device, Fig. 1, for establishing tool-point location. Said to be one of the most accurate instruments of its kind available, the gage permits precision location of the tool point within 0.000025 inch in relation to the work-piece. Featuring speed and ease of operation it does not require specially trained operator's skill beyond that needed to run the basic machine on which it is used.

The gage is designed to eliminate troublesome eyestrain sometimes experienced with conventional optical methods of tool setting. Damage to the tool point associated with the touch or contact method of tool setting is also eliminated, since no physical contact is made with the tool point itself.

A compact portable package of two basic units, the Tool-Tronic gage consists of a gage-sensing head and the cabinet housing two indicating meters. The gage-sens-

ing head is mounted vertically over the tool position which houses the light source lenses and photosensing cells. This unit, shown diagrammatically in Fig. 2, is connected electrically to the reading cabinet which houses an electronic amplifier power supply and two tool-location indicating meters.

In operation the tool is introduced into the orifice of the gage-sensing head so that it interrupts a part of the precision light rays passing from the light source to the photosensitive cells. The distribution of remaining light by-passing the tool is picked up by the photosensitive cells, which, in turn, show any given tool position. These positions are recorded on the two meters in the cabinet. Zero readings on the X and Y axes are reached by moving the tool with machine table and cross-slide. The tool point is then in position at a known location with reference to the work-holding spindle center line and flange face. Return and repeatability to this position are positive.

Circle 585 on Readers Service Card

Fig. 1. Heald Tool-Tronic tool-setting gage, cabinet, and sensing-head equipment

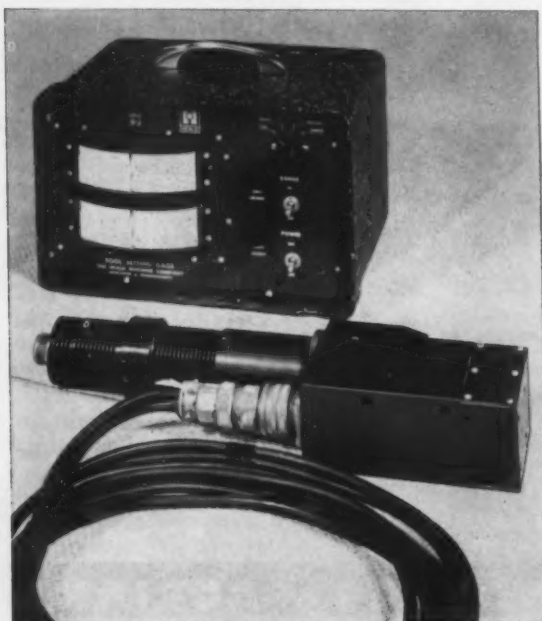
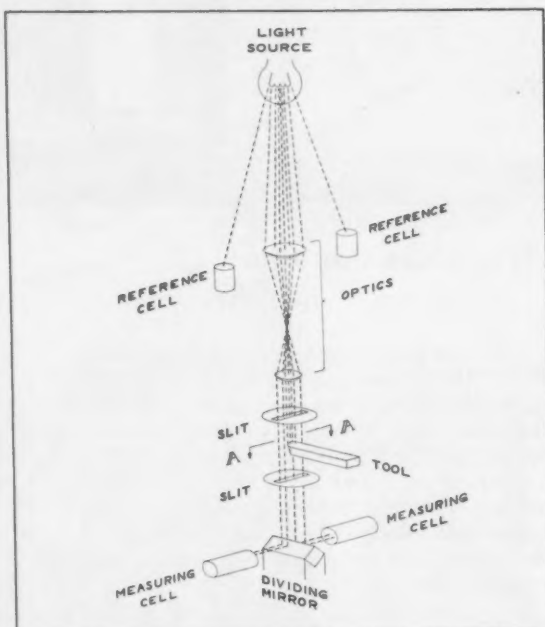



Fig. 2. Diagram of Tool-Tronic sensing head and tool illustrating operating principle





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THE EXTRUSION OF AN AUTO-
MOTIVE BEARING RACE

1. Slug starts as $\frac{3}{4}$ " diameter cut-
off from coil stock. 2. Impacted to
1-1/16" diameter. 3. Extruded to
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*and success is yours
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EXTRUDOIL #51 DO CONCENTRATE

MACCO EXTRUDOIL #51 DO CONCENTRATE

- REDUCES PRODUCTION COST . . . INCREASES PRODUCTION DUE TO LESS DOWN TIME BECAUSE OF TOOL CHANGES
- FREER FLOWING OF METAL ASSURES MAINTENANCE OF ABSOLUTE TOLERANCES
- CUTS INVENTORY COST — ONE LUBRICANT DOES ALL THE JOBS
- CUTS DIE TRY-OUT TIME

Why is Macco Extrudoil #51 DO Concentrate the first choice of experienced cold extrusion men? The answer is easy . . . Macco research and development, working hand-in-hand with leading extrusion equipment manufacturers, developed this Extrudoil to meet the distinct needs of cold extrusion. Result—today Macco Extrudoil #51 DO Concentrate is far ahead of the field . . . proved in production beyond question . . . used every day in the extrusion of screws, bolts, nuts, bearing races, spark plug shells, worm shafts, gears, tappet bodies, sleeves. If you are now engaged in cold extrusion, or even thinking about it, it will pay you well to talk to a Macco engineer. There's one in your area. If you don't know him, write, wire or phone us. We'll have him see you.

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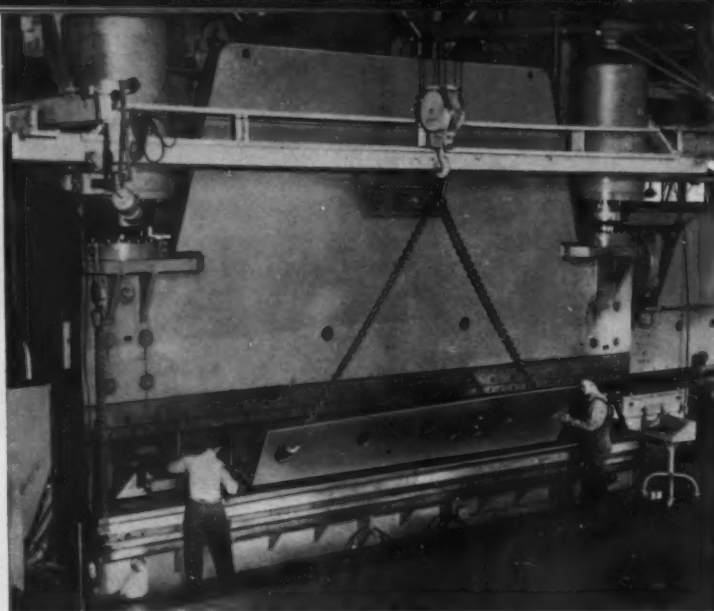
Verson Metal-Bending Press

A huge Verson press believed to be the most powerful metal-bending machine of its type ever built has been installed by the Harnischfeger Corporation in its Milwaukee, Wis., plant. This machine, built by the Verson Allsteel Press Co., Chicago, Ill., will, at the touch of a button, deliver 4,000,000 pounds (2000 tons) of pressure—enough to shape giant sections of superstrength alloy steel measuring 26 feet wide and 1 1/4 inches thick.

Some idea of the size and complexity of the machine may be gained from the fact that 1000 gallons of fluid are required to fill its hydraulic system. The machine covers more than 350 square feet of floor area, rests in a pit 11 feet below the floor, and extends more than 21 feet into the air. From a weight standpoint, it tips the scales at a half-million pounds. Thus, it has a work capacity of about eight times its own weight.

The machine is now being used to shape trolley sections for overhead cranes, excavator dipper sticks, bucket shells, cable drums, cab base frames, and other components for widely diversified products of the company.

Circle 586 on Readers' Service Card



Superstrength alloy steel is being fed into huge Verson self-contained hydraulic press brake recently installed at the main plant of Harnischfeger Corporation in Milwaukee

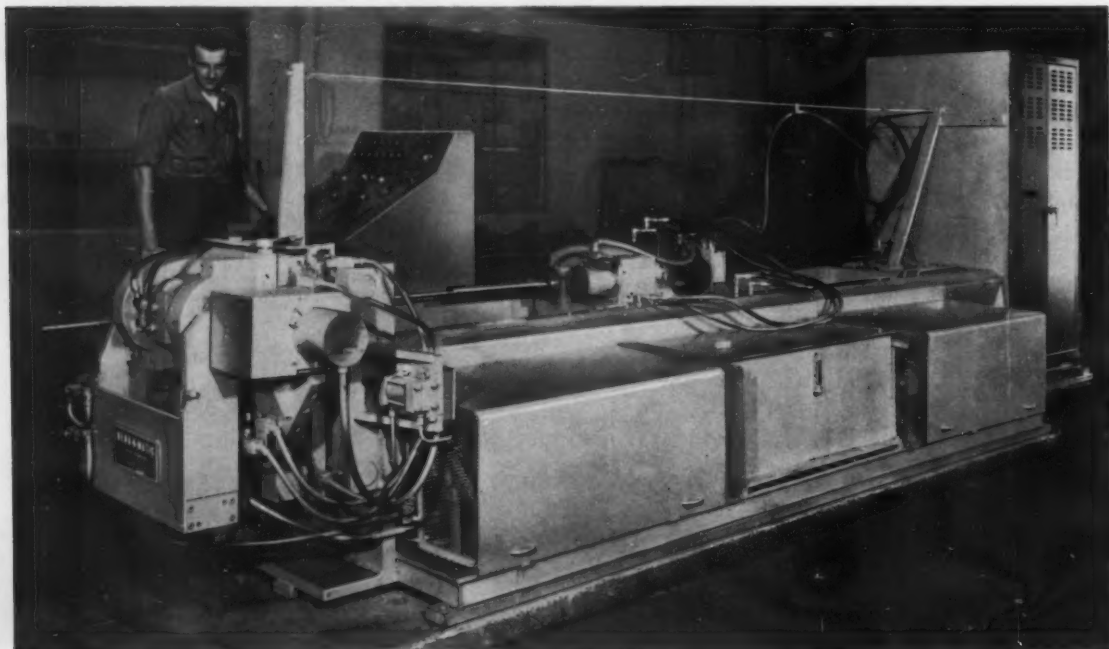
Automatic Numerically Controlled Tube-Bending Machine

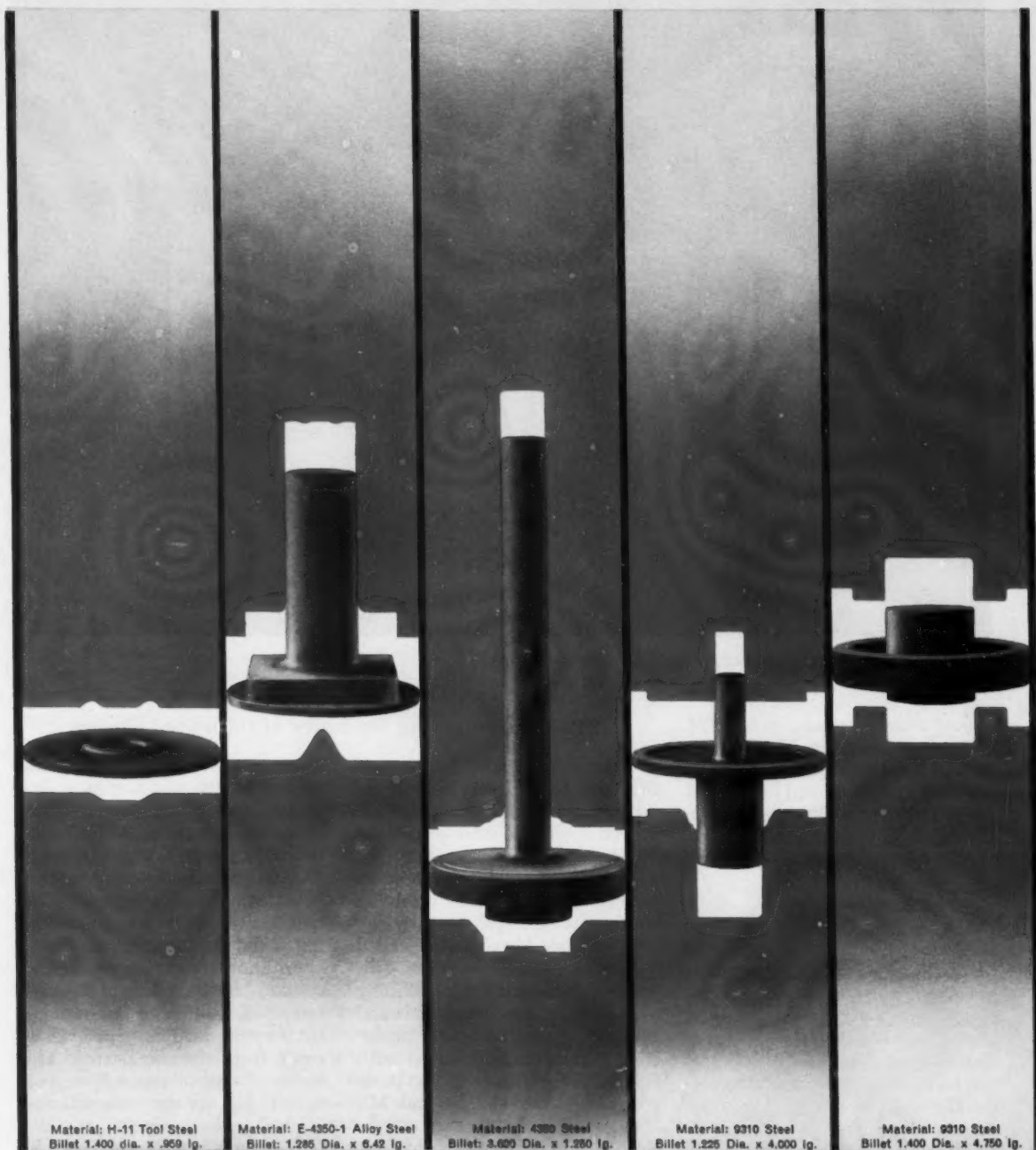
A numerically controlled bending machine developed especially for the production of bent tubing for precision aircraft and missile installations is now available from Nu-Era Corporation, Rochester, Mich. This is said to be the first numerically controlled tube-bend-

ing machine ever produced having tape-writer and tape-reader equipment made an integral part of the control console, as illustrated.

Designated the Bend-O-Matic, the machine was designed and built for Nu-Era by Walter P. Hill, Inc., Detroit, Mich. It will handle

Nu-Era Bend-O-Matic numerically controlled tube-bending machine



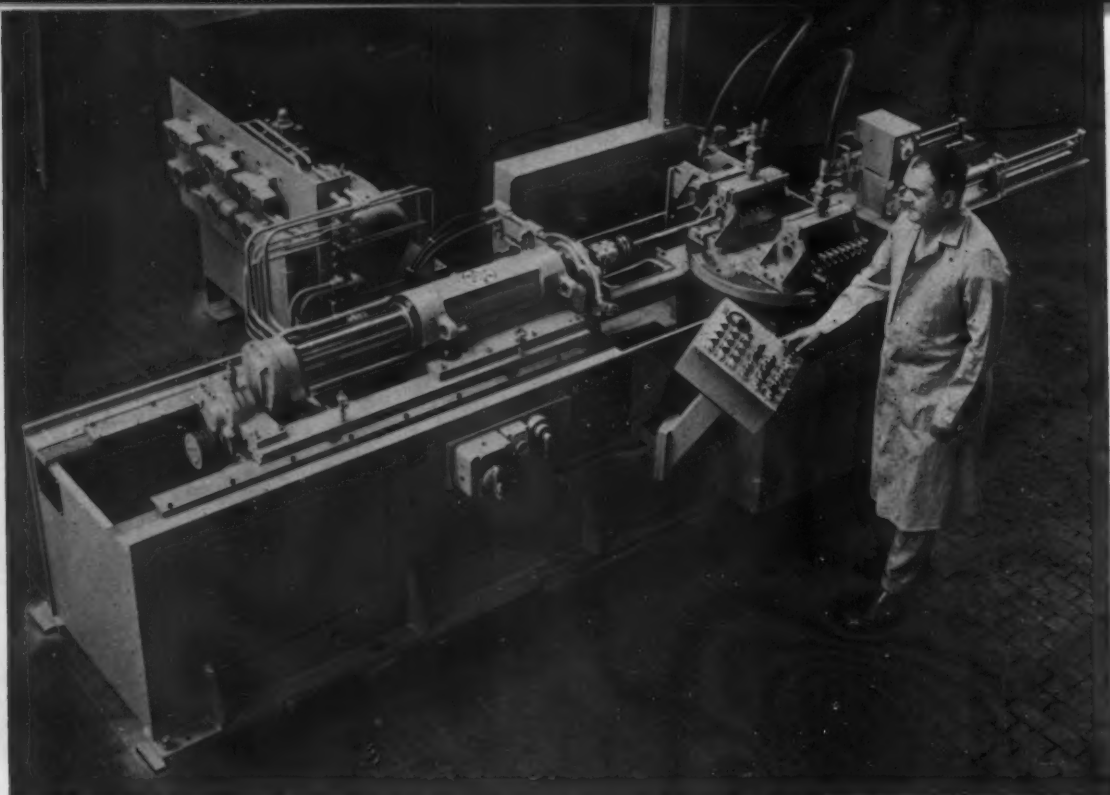


High-Energy Rate PRODUCTION ABILITY in one dynamic stroke! In this advanced, highly technical field, DYNAPAK high-energy rate metalworking equipment maintains consistent leadership through proven production ability. In support of this recognized position, illustrated above are forgings from BENDIX CORPORATION-UTICA DIVISION, where DYNAPAK is demonstrating its performance reliability in day-after-day production runs. DYNAPAK one-shot forging, extruding and metals compaction equipment increases savings, improves metal properties and reduces waste material. Closer tolerance controls, and the low micro finish of the "as forged" parts, are distinct advantages in DYNAPAK metalworking machines. Conventional or exotic materials, simple or complex shapes . . . DYNAPAK has few limitations. DYNAPAK metalworking machines are capable of making a part — in one stroke — that can be put to use with little or no machining. Apply DYNAPAK to your metalworking operations — it's the only *really new* proven concept in the industry.

Write for complete information to: Advanced Products Department, P.O. Box 6231, San Diego 6, Calif.

GENERAL DYNAMICS

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Improved stack-Microhoning machine equipped to finish wrist-pin bores in connecting-rods developed by Micromatic Hone Corporation

tubing of any material up to 1 1/4 inches in diameter and 8 feet long. Repeat bending is performed with absolute dimensional fidelity. Bend and twist angles are held to tolerances of plus or minus 3 minutes and linear dimensions to plus or minus 0.005 inch.

Reduction in setup time achieved with the new machine is of special importance in short-run production and replacement-part manufacturing operations. Complete change-over from production of one bending pattern, tube diameter, and radius to another can be made in thirty-five minutes for the average setup. Only one minute is required to change a bending pattern on the same tube. The Bend-O-Matic will also accommodate existing dies from any standard conventional bending machine. It is provided with adapter blocks that will fit any existing bending tooling.

Once a program has been punched on tape, it can be used repeatedly to produce the same part to close dimensional tolerances. The tape can be stored in minimum space and put back into the machine at any time.

Circle 587 on Readers' Service Card

Stack-Microhoning Machines of Improved Design

Greater accuracy, longer tool life, and reduced cycle time are advantages claimed for the improved horizontal stack-Microhoning machines announced by the Micromatic Hone Corporation, Detroit, Mich. These machines employ a technique recently developed by Micromatic, called horizontal stack-Microhoning. This process is adapted for finishing such parts as connecting-rods and gears in which the length of the bore is comparatively short with respect to the diameter. The parts are stacked horizontally and Microhoned as "one long work-piece." The advantages of this method, compared to former setups on four- or six-spindle vertical machines, include higher production rates; greater machine simplicity and reliability, since only one spindle is used; and greater abrasive economy through the use of longer stones.

This new machine, designated Model 5HXXH-16, has a shorter, more rigid base than preceding models. The shorter base and a shorter tool bring the work closer to the quill, thus making the tool

more rigid. Accuracy also is improved by the addition of a new tool adapter which minimizes tool runout. An automatic hydraulic probe prechecks for proper clearance in the bored holes. Another new feature is an integral shot-bolt locator for positive positioning of the indexing fixture.

An improvement in the coolant system, including larger distribution lines, assures maximum coolant flow to facilitate removal of swarf from the work area. The operator control panel is repositioned for greater convenience when changing tools.

The wrist-pin bores in eight connecting-rods are finished at one time on the machine illustrated. An average of 0.0025 inch of stock is removed from each rod to generate the final size in the 0.926-inch diameter by 1.032-inch long bore. The diameter tolerance is held to 0.0003 inch, and straightness and roundness are held to 0.0002 inch. Surface finish is controlled to suit specifications. Estimated gross production is 640 parts per hour.

Circle 588 on Readers' Service Card

Simplified method of checking for GEAR ANGULAR ERROR

RICHARD L. THOEN

General Mills, Inc., Minneapolis, Minn.

Experience has shown that the great bulk of angular error patterns are relatively smooth. As a consequence, the maximum angular error can be established with about 10 readings. Thus, instead of a separate indexing instrument, angular error can be checked with a small optical polygon mounted directly on the gear mounting arbor (or gear shaft), Fig. 1, thus eliminating the bothersome measurement errors due to (a) runout of an indexing spindle, (b) the driver coupling between an indexing spindle and the gear mounting arbor (or gear shaft) and (c) skewness between an indexing spindle axis and the gear axis. It should be noted that the polygon mounting is not critical. A decentered polygon introduces no error, and the effect of wobble is usually insignificant.

Gear roll tester used

A gear roll tester is ideally suited for checking angular error, Fig. 2. The measuring slide is set to the proper center distance (i.e., to the center distance at which the pawl contacts the work gear inside form radius) and locked. The polygon is mounted on the gear mounting arbor (or gear shaft). The gear and pawl are mounted in the roll tester, the micrometer brought to the mid-position and the autocollimator is zeroed on a polygon face. To measure angular error, the pawl is rotated out of mesh, remeshed so as to bring an adjacent face into view, and the angular error is read in the autocollimator. The friction in the mounting centers is sufficient to keep the driven profiles in contact with the pawl.

In cases where the number of work gear teeth is not a multiple of the number of polygon faces, a slight pawl rotation (never more than $\frac{1}{2}$ tooth) is necessary. If the number of pawl teeth is not less than 40 (on a full circle), the pawl rotation will never exceed $\pm 4.5^\circ$. Over this range, for a suitable arm length, it is usually permissible to use the approximation 0.001 inch/minute of arc in presetting the pawl.

If desired, peak readings can be checked for the possibility of higher peaks by comparing changes in micrometer settings against corresponding changes in autocollimator readings.

A side advantage of checking for angular error on a gear roll tester is that erratic readings can be checked for dirt and burrs by simply releasing the measuring slide lock and reading the tooth-to-tooth composite error.

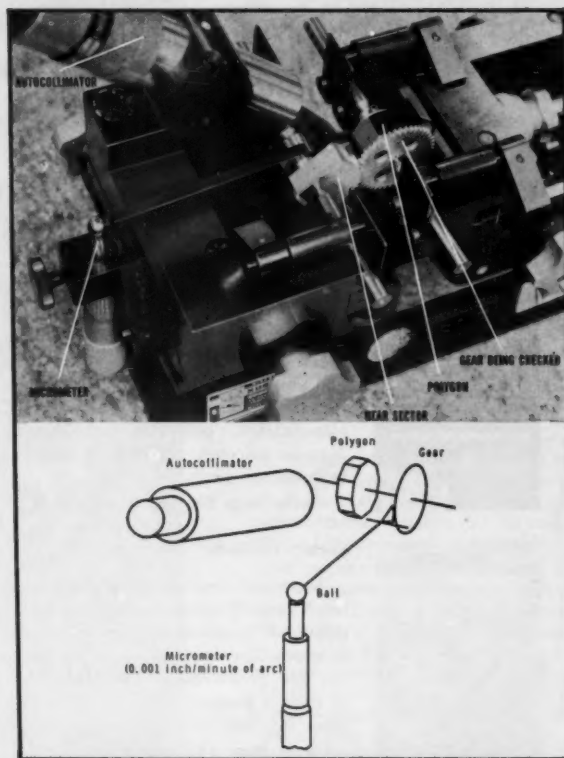


FIG. 1. A simplified method of checking for gear angular error.



FIG. 2. An S & F gear roll tester set-up for checking angular error.

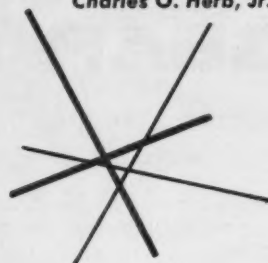
The foregoing was extracted from a paper presented at the International Conference on Gears and Gear Drives held at Essen, West Germany, October 18 and 19, 1960. It is presented here as a service to the fine-pitch gear industry. Reprints are available on request to Gear Division, Kurt Orban Company, Inc., 1259 U.S. Route 46, Parsippany, N. J.

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Silicone Rubber

Mechanical Rubber Products Co., Warwick, N. Y. Bulletin on the uses and abuses of silicone rubber. Data on processing, cost, source of supply, classification, properties of general-purpose silicones, and use of silicones in fluids are given.

Circle Item 501 on Inquiry Card



Spring Products

Associated Spring Corporation, Bristol, Conn. Brochure aiding manufacturers of products containing springs in controlling costs of handling, quality, and procurement. An explanation of custom packaging for various spring types is given.

Circle Item 502 on Inquiry Card



Dies, Tools, and Fixtures

Hercules Machine Tool & Die Co., Warren, Mich. Circular showing automotive drawings and a wide range of parts which were made with the company's dies, tools, and fixtures. Designing, engineering, body die facilities, etc., are covered.

Circle Item 503 on Inquiry Card



Diamond Products

Koebel Diamond Tool Co., Detroit, Mich. Catalogue No. 861 on the firm's "Cemented Diamond Particles," securely held in position by means of a Koebelite powdered-metal matrix. Round, rectangular, blade shapes, etc., are available.

Circle Item 504 on Inquiry Card



Flaw Location

Turco Products Inc., Wilmington, Calif. Catalogue featuring information on the Turco Dy-Chek method of flaw location. It can be used to locate porosity or pin-holes in welds, porosity or cracks in castings, cracks or laps in forgings, etc.

Circle Item 505 on Inquiry Card



Form-Relieving Fixture

R-O Mfg. Co., Madison Heights, Mich. Brochure detailing R-O equipment and methods for performing form-relief grinding on a variety of cutting tools. Setup and operations of the fixture and grinder are explained with diagrams and photographs.

Circle Item 506 on Inquiry Card



Drill Pointers

Oliver Instrument Co., Adrian, Mich. Bulletin providing technical information on the Oliver of Adrian Model 600 drill pointer, machines for wet and dry grinding, fully automatic drill pointer with automatic infeed, and drill-point thinner.

Circle Item 507 on Inquiry Card



Dust Control

Pangborn Corporation, Hagerstown, Md. Bulletin 922A on methods for controlling industrial dust and fumes. Included are a new electric furnace exhaust hood and "CO" cloth tube collector for high-temperature, corrosive-gas applications.

Circle Item 508 on Inquiry Card



Electronic Tracer

Linde Company, division of Union Carbide Corporation, New York City. Booklet (Form 55,043) on the Linde photocell tracer with a built-in kerf compensator for reproducing one or thousands of complicated metal parts from exact-size drawings.

Circle Item 509 on Inquiry Card



Boring Machine

Olofsson Corporation, Lansing, Mich. Brochure on the Model 21 single-end precision boring machine designed for fast and accurate finish-boring, facing, chamfering, turning, grooving, gun-drilling, bore-reaming, and similar metal-removing operations.

Circle Item 510 on Inquiry Card

for KING SIZE precision gaging **Starrett®** long range dial indicators

With these new Starrett long range dial indicators, you can measure with continuous accuracy over ranges of up to *five inches*. Direct reading count hands and double dials let you read any dimension within the full range directly in thousandths of an inch . . . making them ideal for production measuring on boring machines and similar machine tools, as precision stops on lathes and for jig and fixture work and other long range gaging.

Available in 12 catalog models covering ranges of 2.000", 3.000", 4.000" or 5.000" — each in a choice of indicator dimensions conforming to A.G.D. specifications, groups 2, 3 and 4, except for range and stem length.

Your nearby Industrial Supply Distributor can supply Starrett high precision-low friction dial indicators in 144 models to meet every requirement — plus dial test indicators, dial comparators, bench gages, bore gages, portable hand gages and inside dial gages. A specialist in prompt, dependable service, he'll give you quick delivery on any of the 3500 quality products in the complete Starrett line. Write for Catalog No. 27, The L. S. Starrett Company, Athol, Massachusetts, U.S.A.

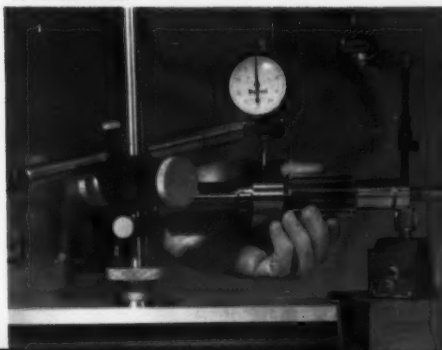
No. 25-106 DIAL-MASTER Super Precision Dial Indicator, No. 196 Dial Test Indicator and No. 711F LAST WORD Dial Test Indicator.



Gaging Part on No. 653 Dial Comparator.



No. 675 Heavy Duty Dial Test Indicator, No. 657C Magnetic Base Indicator Holder with No. 196B Indicator.



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Ideal for all applications requiring extra
long range up to 2, 3, 4 or 5 inches.



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Thread Rolls

Detroit Tap & Tool Co., Warren, Mich. Bulletin E-61 enumerating advantages of thread rolling, with illustrations. Bump type, straddle type, and a range of plunge and through-feed type thread rolls being used on various machines are covered.

Circle Item 511 on Inquiry Card



Index Center

Moore Special Tool Co., Inc., Bridgeport, Conn. Brochure containing information on the Moore "Index Center," a precision tool for inspection work on centers; jig-boring, milling, and jig-grinding work on centers; etc. Specifications are given.

Circle Item 517 on Inquiry Card



Expanding Mandrels

Erickson Tool Co., Solon, Ohio. Catalogue on a complete line of precision expanding mandrels which chuck internally within 0.0005 inch total indicator reading and have tremendous holding power, permitting high cutting speeds and heavy feeds.

Circle Item 512 on Inquiry Card



Drill Sets

Precision Twist Drill & Machine Co., Crystal Lake, Ill. Bulletin No. 461B giving a description of the company's drill sets. Counter-display drill dispensers, high-speed drill assortment, and wire-gage and letter-size drill sets are included.

Circle Item 518 on Inquiry Card



Surface-Grinding Machines

Brown & Sharpe Mfg. Co., Providence, R. I. Bulletin GM 62 covering four Brown & Sharpe Micromaster surface-grinding machines, in 8- by 24-inch, 10- by 24-inch, 12- by 24-inch, and 10- by 30-inch sizes. A specification table is included.

Circle Item 513 on Inquiry Card



Diamond Dressers

Arthur A. Crafts Co., Inc., Boston, Mass. Catalogue giving specifications on diamond dressers, radius dressers, Ex-Cell-O dressers, etc. Information on how to order and data on diamond resetting, diamond dust, wheels, and tools are provided.

Circle Item 519 on Inquiry Card



Knuckle-Joint Presses

Federal-Warco Division, Warren, Ohio. Brochure No. 52400 featuring the Warco line of knuckle-joint presses, in capacities from 100 to 2500 tons inclusive, for such work as coining, extruding, cold-forming, sizing, swaging, heading, and embossing.

Circle Item 514 on Inquiry Card



Surface Grinder

Landis Tool Co., Waynesboro, Pa. Catalogue 618M-61 describing and illustrating the Landis 6- by 18-inch precision hand-feed surface grinder, whose features include high-strength castings and hardened rollers on saddle and table ways.

Circle Item 520 on Inquiry Card



Heavy-Duty Lathe

R. K. LeBlond Machine Tool Co., Cincinnati, Ohio. Bulletin HD-561 containing data on LeBlond's line of NF design 2516 and 3220 heavy-duty engine and toolroom lathes for both heavy turning (forgings, mill rolls, etc.) and delicate precision work.

Circle Item 515 on Inquiry Card



Directional Control Valves

Oilgear Co., Milwaukee, Wis. Bulletin 80300-A on directional control valves with three- and four-way plungers. Manually (hand-lever) operated, mechanically (clevis) operated, hydraulically operated, and solenoid-pilot operated types are included.

Circle Item 521 on Inquiry Card



Tooth-Spacing Checker

Michigan Tool Co., Detroit, Mich. Data Sheet 1132 on a checking system which simplifies analysis of gear and spline tooth-spacing errors. Eccentricity and index errors are separated by graphic means for straight or helical gears or splines.

Circle Item 516 on Inquiry Card



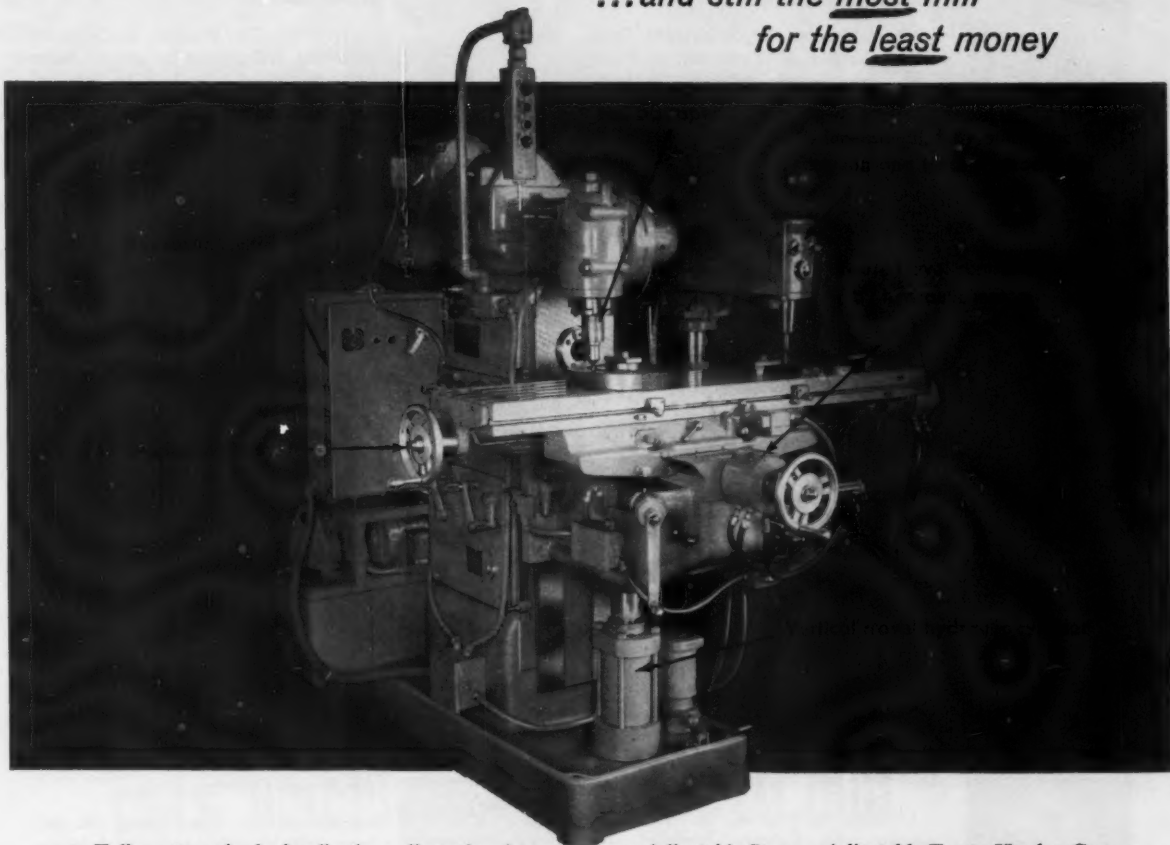
Surface-Grinding Machines

Thompson Grinder Co., Springfield, Ohio. Circular describing the company's "B" and "BB" types of hydraulic surface grinders. Table, base, column, saddle, wheel-head, hydraulic system, lubrication, wet attachments, and wheel dressing are covered.

Circle Item 522 on Inquiry Card

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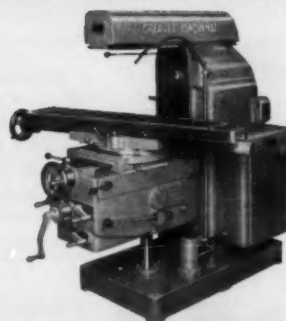


The 2H Mill

Rigid cast construction 5 HP—1750 RPM drive motor. Comprehensive speed-feed ranges. Big job capacity.

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Pneumatic Products

C. A. Norgren Co., Englewood, Colo. Catalogue No. 1000 covering the firm's line of pneumatic products. Featured are descriptions of pressure regulators, air-line filters, oil-fog lubricators, micro-fog lubricators, and Spray-Lube systems.

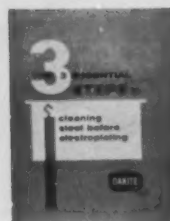
Circle Item 523 on Inquiry Card



Lubricants

Pure Oil Co., Palatine, Ill. Brochure outlining the company's line of industrial lubricants. Puroturbine oils, engine oils, cylinder and heavy mineral oils, textile oils, gear lubricants, miscellaneous oils, and industrial greases are described.

Circle Item 529 on Inquiry Card



Cleaning Steel

Oakite Products, Inc., New York City. Booklet detailing methods of cleaning steel before electroplating. Outlined are specific procedures (materials, concentrations, temperatures, etc.) and recommended materials used for reverse-current cleaning.

Circle Item 524 on Inquiry Card



Lathe Centers

Nielsen, Inc., Lawton, Mich. Bulletin No. 561 describing precision ball-bearing lathe centers and tailstock spindles. Included is information on multiple- and heavy-duty live centers, insert points, and Morse and Jarno taper centers.

Circle Item 530 on Inquiry Card



Web Bender

National Bending Machinery Corporation, Johnstown, Pa. Brochure on the Zig-Zag web bender, which bends rods from 3/8 to 5/16 inch into webs of 8 to 24 inches in depth and 10 to 36 inches in panel width, in continuous lengths up to 60 feet.

Circle Item 525 on Inquiry Card



End Mills and Die-Sinking Cutters

Tomkins-Johnson Co., Jackson, Mich. Catalogue No. 661 featuring the company's entire line of end mills and die-sinking cutters. Also provided are informative data and numerical charts to aid the metalworking engineer on his cutting problems.

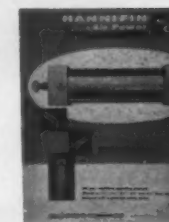
Circle Item 531 on Inquiry Card



Hydraulic and Pneumatic Packings

Chicago-Allis Mfg. Corporation, Chicago, Ill. Circular covering the company's complete line of pneumatic and hydraulic packings—cup, flange, U, vee, O-rings, backup washers, one-piece double-acting piston cups, and double-lip shaft wiper seals.

Circle Item 526 on Inquiry Card



Air Power Cylinder

Hannifin Co., Des Plaines, Ill. Bulletin 0220-B1 giving technical information on Hannifin's 200-psi Series "C" air power cylinder. Described are both single and double rod end models in their five bore sizes ranging from 1 1/4 to 4 1/2 inches.

Circle Item 532 on Inquiry Card



Profilometer

Micrometrical Mfg. Co., Ann Arbor, Mich. Catalogue 161 covering the firm's complete standard line of Profilometer instrumentation for the measurement and control of surface roughness. In addition, many special products are illustrated and described.

Circle Item 527 on Inquiry Card



Gear-and-Pinion Combinations

Gries Reproducer Corporation, New Rochelle, N. Y. Catalogue No. 3001-C presenting die-cast zinc-alloy one-piece gear-and-pinion combinations. Applications include appliance timers, clock works, business machines, electric shavers, etc.

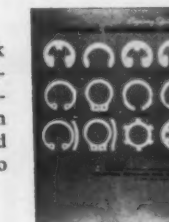
Circle Item 533 on Inquiry Card



Resistance Welding

Oakite Products, Inc., New York City. Booklet giving data on the chemical preparation of aluminum for resistance welding, including cleaning in preparation for deoxidizing, cold and hot deoxidizing, and etch cleaning to obtain a matte finish.

Circle Item 528 on Inquiry Card



Retaining Rings

Industrial Retaining Ring Co., Irvington, N. J. Catalogue No. 61 containing data on the firm's industrial retaining-ring line. Included is information on the new wire stacking of Industrial Series 3000, 3100, 4000, and 4100 retaining rings.

Circle Item 534 on Inquiry Card

CASE HISTORY: Major auto manufacturer cuts cost on steering knuckle with coolant formulated to meet specific job conditions.



Personalized Kerns Cutting Compound cuts machining costs \$20,000 a year

The soluble cutting fluid used in machining operations on the above steering knuckle has a number of things to combat. Tramp oil is constantly seeping into the 5,000 gallon coolant system. It seals off the cutting emulsion creating a bacteria problem, rancidity, and split-out. This results in poor cutting action and tool life. Kerns United helped solve this problem by formulating a personalized lubricant to meet the specific job requirements. Economies realized through usage and extended tool life amount to a savings of twenty thousand dollars a year.

If you have a cutting compound problem, call in the man from Kerns United. He knows how to match tools, metals, and desired end results with a *personalized* lubricant that will perform consistently better... save you money.

Before — Former coolant required complete clean-out four times a year... a costly operation in time and lost production.

After — The Kerns United cutting compound provides a year's use before clean-out is necessary. It contains bactericides that hold bacteria growth to minimum.

Before — Former coolant was mixed 10% concentrate to 90% water.

After — The Kerns coolant is mixed 4% concentrate, 96% water. Lubricity is higher and much less concentrate is required.

Before — Former coolants presented an emulsification problem.

After — Kern's coolant has remained stable at all times.



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Gap Presses

Minster Machine Co., Minster, Ohio. Bulletin 21 giving data on the Series 70 fixed-base open-back gap presses in 45- to 60-ton capacities. Features include cast-iron frame, sliding die cushions, convenient controls, variable speeds and feeds, etc.

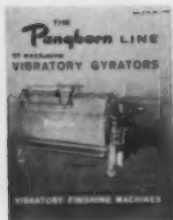
Circle Item 535 on Inquiry Card



Air Control Products

A. Schrader's Son, division of Scovill Mfg. Co., Inc., Brooklyn, N. Y. Catalogue No. 125 on air control products for automating in-plant operations and for component use in new products. Cylinders, valves, rotating joints, filters, etc., are featured.

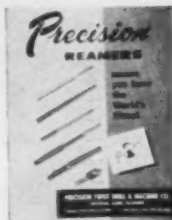
Circle Item 541 on Inquiry Card



Vibratory Finishing Machines

Pangborn Corporation, Hagerstown, Md. Bulletin No. 1703 on the company's line of vibratory gyrotors for cleaning, descaling, deburring, radiusing, grinding, fine finishing, and coloring or burnishing of metal, plastic, and ceramic parts.

Circle Item 536 on Inquiry Card



Reamers

Precision Twist Drill & Machine Co., Crystal Lake, Ill. Bulletin No. 761 providing data on a wide range of precision reamers (chucking, taper pin, Morse, and center). Included are rules for obtaining maximum efficiency and life from reamers.

Circle Item 542 on Inquiry Card



Drilling and Tapping Units

Hypneumat, Inc., Milwaukee, Wis. Bulletin 6100 on the Hypneumat line of high-speed automatic drilling and tapping units. Technical information, specifications, drill thrust charts, tapping-threading data, and typical circuits are covered.

Circle Item 537 on Inquiry Card



Press-Brake Dies

Pacific Industrial Mfg. Co., Oakland, Calif. Catalogue No. 401 on nominal 90-degree V-dies for sheet metal, box-forming dies, flattening, offset and joggle, radius, gooseneck, and universal channel dies. Also described are raising and filler blocks.

Circle Item 543 on Inquiry Card



Plain Milling Machines

Brown & Sharpe Mfg. Co., Providence, R. I. Bulletin MM 56 covering construction, operations, and optional equipment for B&S Dynamaster No. 2 plain milling machines, available with 3-, 5-, 7 1/2, or dual 10/5-hp spindle drive motors.

Circle Item 538 on Inquiry Card



Coil-Handling Equipment

Rowe Machinery & Mfg. Co., Inc., Dallas, Tex. Circular presenting a line of coil-handling equipment. Cradles, reels, straightening machines, combination units, straightening and feeding machines, press feeds, and sheeting lines are described.

Circle Item 544 on Inquiry Card



Cam-Indexed Roll Feeds

Ferguson Machine Co., St. Louis, Mo. Catalogue No. 500 on cam-indexed Camtrol roll feeds for precision feeding of dynamically controlled roll and strip stock at rates exceeding 3000 ipm. Data include graphs for determining operating speeds.

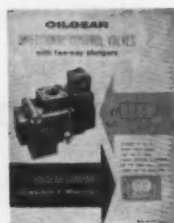
Circle Item 539 on Inquiry Card



Air Clamp Type Cylinders

Sheffer Corporation, Cincinnati, Ohio. Bulletin No. 861 on the "CLA" series 1 1/8-inch clamp type 150-psi air, 250-psi hydraulic cylinder with universal, clevis, pivot, or stud mountings, plus a compact Val-N-Head solenoid-operated cylinder.

Circle Item 545 on Inquiry Card



Directional Control Valves

Oilgear Co., Milwaukee, Wis. Bulletin 80200-A containing data on the company's line of two-way directional control valves in sizes from 1/2 to 3 inches and for fluid power systems up to 3000 psi. Specification and capacity data are given.

Circle Item 540 on Inquiry Card



Vibration Measuring

Korfund Co., Inc., Westbury, N. Y. Bulletin K-19A on a range of instruments produced for Korfund by Philips of the Netherlands for measuring, recording, and analyzing vibration and strain. Vibration transducers and exciters, etc., are covered.

Circle Item 546 on Inquiry Card



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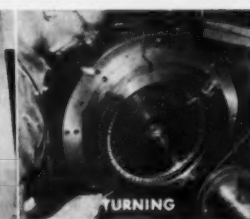
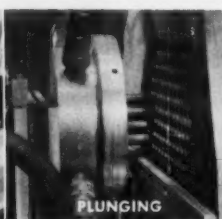
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MACHINING
PROBLEMS**

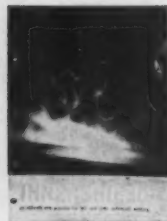
• Yours for the asking . . . use postcard between pp. 191 & 192



Lathes

Farrel-Birmingham Co., Inc., Rochester, N. Y. Brochure 1218 containing information on Farrel-Betts heavy-duty three-way bed lathes, which range in capacities from 32- to 9-inch swing. Included are complete machine specifications.

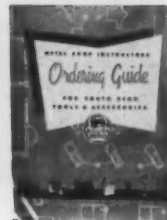
Circle Item 547 on Inquiry Card



Welding Process

Lincoln Electric Co., Cleveland, Ohio. Bulletin No. 5300.1 describing vapor-shielded arc welding and the semiautomatic "Innershield Squirt" and fully automatic "Innershield" welders. Construction details and mechanical features are listed.

Circle Item 548 on Inquiry Card



Hydraulic Presses

South Bend Lathe, Inc., South Bend, Ind. Catalogue No. 6106 covering South Bend's presses—30-, 50-, 75-, and 100-ton Hydrolair and 30-ton hydraulic laboratory types. Diagrams of the "Power-Petuator" air-hydraulic intensifier are provided.

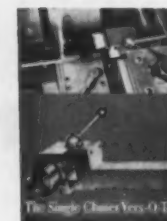
Circle Item 549 on Inquiry Card



Speed Reducers

D. O. James Gear Mfg. Co., Chicago, Ill. Catalogue No. 42C on single-reduction, right-angle spiral bevel-gear reducers of both horizontal and vertical design. Formulas for gear speed-reducer selection, tables, and drawings are provided.

Circle Item 550 on Inquiry Card



Threading Tool

National Acme Co., Cleveland, Ohio. Bulletin SVT-1 on the single-chaser Vers-O-Tool, in two sizes for fine or coarse threads, for use on any lathe equipped with a lead-screw and for cutting taper threads with any standard taper attachment.

Circle Item 551 on Inquiry Card



Welder

Lincoln Electric Co., Cleveland, Ohio. Bulletin No. 4609.1 providing details on a line of Lincoln welding machines. The Idealarc R3M three-phase rectifier type direct-current arc welder is said to handle any type of manual arc-welding electrode.

Circle Item 552 on Inquiry Card



Boring Heads

Giddings & Lewis Machine Tool Co., Fond du Lac, Wis. Catalogue No. D-530-A featuring the CF-6E continuous radial-feed head, added to the Davis "CF" line for small-diameter boring, facing, turning, back facing, grooving, and chamfering operations.

Circle Item 553 on Inquiry Card



Machine Tool Control

Hughes Aircraft Co., Los Angeles, Calif. Brochure covering the company's transistorized positioning control system, which provides automatic positioning of a two-axis table from a pre-programmed 1-inch tape. A third axis of control can be added.

Circle Item 554 on Inquiry Card



Draw-Keys

Giddings & Lewis Machine Tool Co., Fond du Lac, Wis. Bulletin No. D-142 providing data on Davis adjustable draw-keys, which use an expanding plunger to draw Morse taper-shank tools firmly into the machine spindle. Specifications and prices are given.

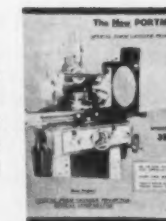
Circle Item 555 on Inquiry Card



Material-Handling Equipment

Vince Basnik Co., Cleveland, Ohio. Catalogue presenting the firm's entire line of material-handling equipment. Work-benches and accessories, tool cabinets, stands, stock carts, trucks, dollies, drum lifters, swivel hoists, and hooks are described.

Circle Item 556 on Inquiry Card



Optical Form-Grinder Projector

Portman Instrument Co., Larchmont, N. Y. Circular on the OFG-300 optical form-grinder projector-comparator for use on standard surface-grinding machines. It is furnished with a focusing work-table, surface illumination attachment, etc.

Circle Item 557 on Inquiry Card



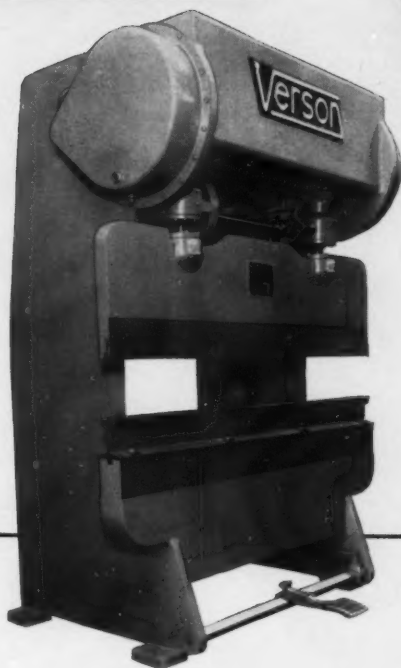
Tape-Controlled Lathe

American Tool Works Co., Cincinnati, Ohio. Bulletin 912-A-1 on a tape-controlled lathe with Minuteman coordinate setup. It performs turning, facing, boring, and form-tooling operations and handles roughing and finishing with equal ease.

Circle Item 558 on Inquiry Card

NEW VERNON DESIGNS GIVE YOU NEW HIGHS IN PERFORMANCE

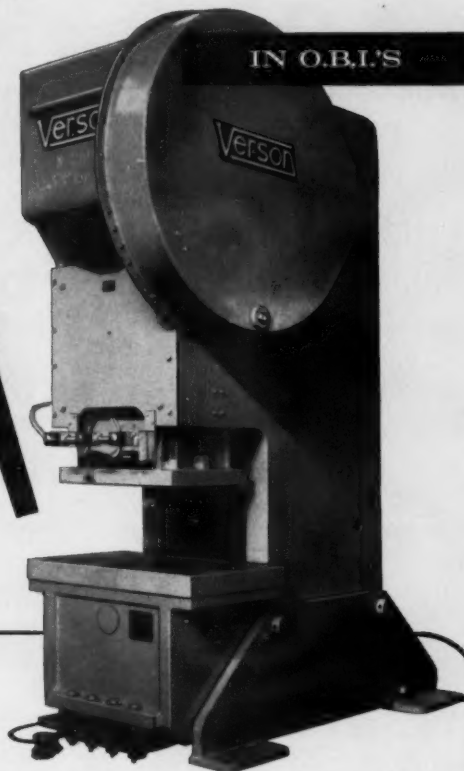
IN PRESS BRAKES



- Solid main and intermediate bearings of bronze
- Oversize twin disc friction clutch
- Long square type body gibs
- Herringbone gears, all operating in oil, double end drive
- Spring loaded adjustable clam shell brake
- Power adjustment of ram
- Coupling unit for accurate leveling or tilting of ram
- Centralized lubrication

Complete range of capacities
and sizes from 50 tons up.
Other models from 15 tons up

IN O.B.I.'S



- Full eccentric drive—no crankshaft
- Solid main and pitman bearings of nickel bronze
- Interconnected clutch and brake
- Completely redesigned press frame for better deflection standards
- Square type extra long gibs adjustable left, right, front or back
- Non-oscillating slide adjustment screw
- Herringbone type gears, all operating in oil
- J.I.C. die space

Geared and flywheel models
from 75 tons up

Ask your Vernon Representative for full
information, or write for descriptive literature.

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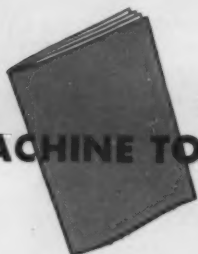
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260

catalogues bulletins manuals

• Yours for the asking . . . use postcard on following page

MACHINE TOOLS



For additional information on the Cleveland Crane line of mechanical and hydraulic **PRESS BRAKES** circle 40

New Britain Machine Co. offers catalog featuring their new line of **COPYING LATHES**. To obtain catalog circle 55-58

To obtain catalogs on the Cincinnati Shaper line of mechanical and hydraulic **PRESS BRAKES** circle 63

For detailed information on the Verson line of **PRESSES** and **PRESS BRAKES** Circle 189

Anocut Engineering Co. offers booklet titled "Fact Pack" featuring their Modern **ELECTROLYTIC MACHINE**. Tool never touches workpiece—No friction, tool wear, heat or sparks. To obtain "Fact Pack" circle 187

For complete information on the Michigan Tool and Michigan Lorenz line of **HOBBERS** and **SHAPERS** circle . . . 213

For additional information on the Sheldon Machine Co.'s line of **LATHES** use postcard on page 214

Bliss Company offers detailed, full color catalog featuring their **INCLINABLE PRESSES**. To obtain circle 221

Hamilton Tool Co. offers bulletin on their **TAPPING MACHINE**. To obtain circle 224

For additional information on the Seneca Falls Machine Co.'s completely automatic, numerically controlled model 400 **TRACER LATHE** circle 232

Beatty Machine Co. offers literature on its complete line of **PUNCHES, PRESSES, SHEARS** etc. To obtain circle 240

Nebel Machine Tool Co. offers complete, illustrated story on their revolutionary turning **LATHE**. To obtain circle . . 241

For complete information of the L & J Press Corporation's line of 14-150 ton O.B.I., 20 to 150 ton Straight Side and 30 to 75 ton Gap Frame **PRESSES** circle 242

Robert E. Morris offers free showing of a 16 MM sound and color movie featuring their "Twin Mill" **MILLING MACHINE**. For additional information see **INSIDE BACK COVER**.

CUTTING TOOLS



Armstrong-Blum offers bulletin illustrating and describing their "Universal Metal Cutting" **BAND SAWS**. To obtain circle 72

Niagara Machine & Tool Co. offers bulletins on each of their versatile **SHEARS**. For correct bulletin numbers see advertisement on page 193

TY-SA-MAN Co. offers a brochure which pictures and describes the functions of their many metal **SAWS**. To obtain circle 220

MISCELLANEOUS



Textile Machine Works—booklet "Facilities File Folder" describes their **SUB-CONTRACTING** facilities. To obtain circle 22

Texaco—**CUTTING OIL** booklet "Clear-tex in Automatic Screw Machines" features cutting oil dilution. To obtain circle 54

Gulf Oil offers literature on their "Heavy Duty" **COOLANT** Gulfcut. To obtain circle 159

Schrader Co. offers new catalog featuring the complete range of sizes and types of their **AIR CIRCUITRY** products. To obtain circle 219

Eldlund Machinery Co. offers descriptive bulletins on their **PRINTED CIRCUIT BOARDS**. Programmer can prepare tape directly from draftsman's artwork. To obtain circle 223

Oakite offers new bulletin on the successful cleaning of "Missile Propellant Systems." To obtain circle 230

UNIT PARTS



Boston Gear offers a catalog featuring their line of **REDUCTORS** and **RATIO-MOTORS**. To obtain this catalog circle 24

National Acme Co. offers 44-page bulletin on their line of **THREADING** tools. To obtain circle 41

Universal Engineering Co., offers a new catalog on their complete line of **DRILL BUSHINGS**. To obtain circle 75

Laminated Shim Co. offers illustrated catalog "SHIM Design Folder #4." To obtain circle 88

Cincinnati Gear Co. offers brochure on their line of custom **GEARS** and Gear Boxes. To obtain circle 165

New Le Blond bulletin features their "Regal" **HEADSTOCK**. With this new Headstock you can start with manual controls and add hydraulics in your shop at any time. To obtain circle . . 168-169

For complete information about the new line of Allen-Bradley **STARTERS** circle 217-218

Wesson Corporation offers a new 8-page booklet analyzing all the factors involved in picking the best type of tool—for **TURNING OPERATIONS**. To obtain circle 204-205

*feel free to use cards below ...
to obtain free literature on products
advertised or described in this issue*

1. Circle page numbers of advertisements—if no page number appears on ad, refer to advertisers' index.
2. Circle item numbers of new equipment, catalog descriptions.
3. Mail . . . we'll do the rest.

For Advertisements—Circle Page Numbers

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COVERS: FRONT — INSIDE FRONT — INSIDE BACK — BACK

For New Equipment, Catalogues—Circle Item Numbers

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For New Equipment, Catalogues—Circle Item Numbers

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information center

Reverse side of this card gives instructions on how to use postcards below to obtain new catalogues, data on new equipment described, and products advertised in this issue.

This card expires January 1, 1962

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Permit No. 53
New York, N. Y.

BUSINESS REPLY MAIL

No Postage Stamp Necessary if Mailed in the United States

POSTAGE WILL BE PAID BY

MACHINERY

93 WORTH STREET

NEW YORK 13, N.Y.

READERS' SERVICE DEPT.



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FIRST CLASS
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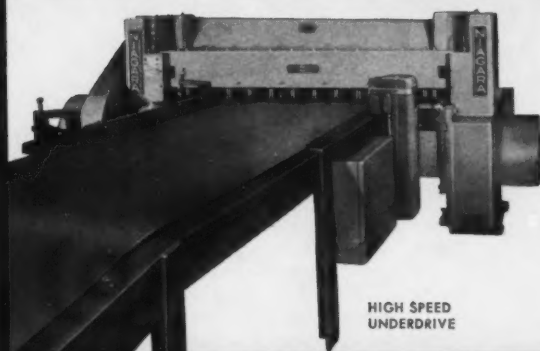




UNDERDRIVE

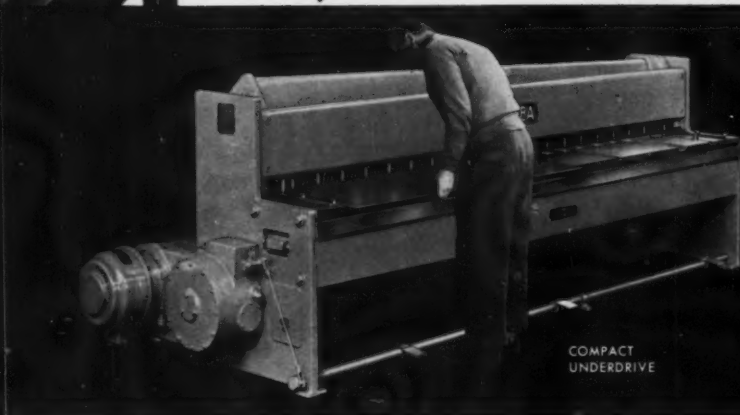


GAP TYPE



HIGH SPEED
UNDERDRIVE

choose the exact shear from
the largest line anywhere!



COMPACT
UNDERDRIVE



FOOT and
AIR OPERATED

Why compromise on a "nearly right" machine? Choose *Niagara* and you'll choose exactly what you need—for 1" plate or paper-thin sheet metal . . . short pieces or 20' lengths . . . automated high speed production or single stroke operation. Niagara has the world's largest selection of squaring and other types of shears . . . nearly 150 models.

Rugged underdrive and gap type giants for heavy industry and steel warehouses. "Middleweights" for medium gage

material. Economy power and foot shears for the sheet metal shop. Slitting and ring and circle shears. Yes, even hand snips! There's no line like the *Niagara* line . . . anywhere!

Next time you need shears of *any kind*, take advantage of the greatest range and variety in the business. Select *Niagara*.

Keep the full *Niagara* shear story on file. Send for any or all of these bulletins:

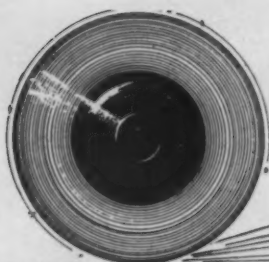
NIAGARA

NIAGARA MACHINE & TOOL WORKS • BUFFALO 11, N. Y.

District Offices and Distributors Everywhere

Underdrive Power Squaring Shears (to 1" plate)	Bulletin 69
Power Squaring Shears with Gap (to 3/8" plate)	Bulletin 72
Power Squaring Shears (Medium Gage)	Bulletin 73
Power Squaring Shears (Light Gage)	Bulletin 71
Air Power Squaring Shears	Bulletin 87
Foot Squaring Shears	Bulletin 80

America's most complete line of presses, press brakes, shears, other machines and tools for plate and sheet metal work.



By E. S. Salichs

BETWEEN GRINDS

Diamond Knives— Not for Wives

People engaged in biological and metallurgical research may purchase from the Mechanical Research Laboratory at Du Pont diamond-edged knives which will slice metal to a thickness of a half-millionth of an inch. R. Earl Sugg, of the laboratory, said, "While the knives were produced to meet a need within the Du Pont Co., we see an opportunity to provide a service for research outside Du Pont." He also pointed out that as far as precision machining is concerned, "tolerances obtained by mechanical means have traditionally been in the neighborhood of 0.0001 inch. The diamond knife will turn out surfaces to tolerances ten times more accurate." So here's to flashing—and sparkling—knives!

Buying a Bridge?

The first bridge fabricated with numerically controlled machining is now under construction at the R. C.

Mahon Co. It was stated in *Industrial Research Newsletter* that cost savings of 85 per cent in producing holes are being realized with automatic drilling by a new tape-controlled unit. The bridge will span the Ohio River.

Tell-Me-True Telemetry

Midas, a miniature data acquisition system, according to its designer, Unilectron, Inc., is a tool which measures human or machine stress. The telemetry system is capable of sensing and transmitting respiration rate, heartbeat, pressure, strain, and acceleration encountered in the environment surrounding man and machine. Thank goodness man still gets top billing.

Peppered but Protected

The American Rocket Society recently witnessed a test which demonstrated that a thin skin could protect a space ship from meteoroids and reduce over-all weight of its outer walls 50 per cent. More than 300 metal pellets were blasted at

speeds up to 13,000 mph into shielded and unshielded targets, representing space vehicle skin. Steel, aluminum, and magnesium sheets, bolted into position on a thick aluminum plate, were used in these tests, according to *Industrial Research Newsletter*.

Need Supertonic Ultrasonic?

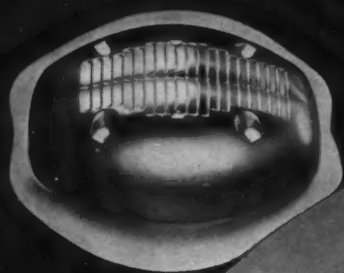
Workers exposed to ultrasonic waves and intense high-frequency noises show harmful physiological reactions, according to Soviet researchers whose conclusions were reported in a recent USSR medical journal. Wonder if they recommended a health camp far from such industrial hazards—the moon, maybe?

The Non-Looking Glass

Swirl, a rough plate-glass pattern made by Pittsburgh Plate Glass Co. and used for partition work for several decades, now has a companion, Stipple. One more and it will sound like a going law firm.



CAST-OFF CANNON CONVERTED
—Two Lockheed Missiles & Space Co. scientists, Eric Rule (facing camera) and Bruce Wilner, are seen here testing a Lockheed-developed velocimeter in "Ye Old Wishing Well"—a converted Army howitzer serving as a pressure chamber in which pressures up to 12 tons per square inch can be created. Construction of such a chamber to test instruments designed to be used at great depths in the ocean would have cost about \$160,000. But a Lockheed administrator, Ernie Le Pera, who was at one time an Army major in Ordnance, came up with the brilliant idea of using a retired Benicia M-1 howitzer. And the Government made one immediately available to the Palo Alto oceanographic laboratory.



CINCINNATI[®] Hydroform

CUTS STREET LIGHT REFLECTOR COSTS

- **Material . . .** controlled thin-out permits use of thinner gauge stock, saving 10¢ a blank.
- **Operations . . .** produces the part in one draw, and eliminates a separate embossing operation.
- **Tooling . . .** flexible diaphragm in machine dome eliminates all overhead tooling and takes the place of more than half of the parts of a conventional die set.
- **Scrap Loss . .** reduced from 5% to less than 1%.

In addition, reflection is improved. Conventional methods cannot reproduce the highly accurate reflector contours required. Hydroforming produces the part as designed.

Similar savings can be yours with Cincinnati Hydroform[®]. For detailed information, write direct or call a Meta-Dynamics Division application engineer.

META-DYNAMICS DIVISION

*Center of Chipless Metalworking
Hydroform • Intraform • Hydrosplin*



THE CINCINNATI MILLING MACHINE CO.

Cincinnati 9, Ohio



GOSS & DE LEEUW
AUTOMATIC CHUCKING MACHINES
perform one to three operations in sequence or simultaneously . . .

TO CUT PRODUCTION COSTS...

More completely finished parts at the end of the day with no partly finished pieces lying around is the regular accomplishment of Goss & De Leeuw "1-2-3" chuckers. It means complete finishing on one, two or three ends simultaneously or in sequence without tool resetting, rechucking or parts handling. Machining operations may include boring, facing, turning and threading.

Change over from job to job is simple. Cost-cutting is assured on long or short runs. Goss and DeLeeuw Chucking Machines are the only standard machines of their type which operate the "1-2-3" way to reduce costs per piece and step up the number of pieces per hour.

Investigate the opportunities offered by these machines on your production by sending samples of your work for time and cost estimates—Ask for illustrated descriptive literature.

GOSS and DE LEEUW
MACHINE COMPANY, KENSINGTON, CONN., U.S.A.



Mollenberg-Betz open-center, self-contained air chuck

Open-Center Air Chuck Is Self-Contained

The novel M-B self-contained air chuck, available from Mollenberg-Betz Machine Co., Buffalo, N. Y., allows the work-piece to be passed entirely through the center of the chuck body due to its open construction. No external air cylinders or draw-rods are necessary to perform the operational function of this unit. No permanently attached air-supply lines leading to the air chuck are required for the jaw gripping and releasing function. Once air is applied to the inlet valve located on the chuck body, the chuck jaws are activated. The air line can then be removed and the clamping pressure inside the chuck housing is retained. With no permanent air-supply connections, the chuck may rotate, move axially, or travel in any manner with the machine tool on which it is mounted, thereby providing flexibility and adaptability for many applications.

An annular ring type piston inside the main circular housing provides jaw movement and holding power. The jaws all move an equal distance and simultaneously. Thus a cylindrical work-piece is self-centering within a tolerance of plus or minus 0.002 inch total indicator reading. Total holding pressure exerted on the work-piece is a function of the air-supply pressure and the mean diameter at the chuck ring piston. The latter is designed to operate at typical plant air pressure. Released air is exhausted from one side of the piston while pressure is applied to the other side, thereby



HIT IT
HARD!

Take a Ledloy® steel—Inland's famous family of free machining steels—and give it all you've got! Go on—double and triple your normal speeds. Up to 325 sfm is common with Ledloy and believe us, far greater speeds are perfectly possible—up to 450 sfm with high speed tools—600 sfm with carbide tooling. ■ Step up the feed, too. Drill at 40 inches per minute at 750 rpm if you have the equipment for it. Matter of fact, you can't tell how much faster—better—you can do with a Ledloy steel 'til you've pushed

it to the limit. ■ One thing to remember—you won't get these amazing results with just any leaded steel. To get the most out of your equipment, use Inland Ledloy—the original leaded steel. ■ That's right—Inland made leaded steels long before anyone else—has been developing the unique properties of Ledloy steels for more than 20 years—can recommend exactly the right type for your shop and your product. So use Ledloy steels—hit them with all you have...

LEDLOY® STEELS CAN TAKE IT!

the world's most machinable steels

INLAND STEEL COMPANY

30 West Monroe Street • Chicago 3, Illinois



providing pressure operation for fast clamping and releasing.

Standard units provide a 7/8-inch radial jaw movement, allowing 1 3/4-inch diametrical motion.

Sizes are available from 12 to 48 inches inside diameter, and may be used rotating or stationary, horizontal or vertical mount.

Circle 589 on Readers' Service Card

"Building-Block" Slide Units

"Building-Block" equipment developed to facilitate the construction of new production machinery not commercially available, or to convert existing machines into new individually designed units, is available from the Precision Spindle Division of Standard Electrical Tool Co., Cincinnati, Ohio. One type of ball bushing slide, available for hand or power feed in a variety of commercial designs, is shown in the upper view of the accompanying illustration. The center view is of a typical Building-Block assembly around which a machine for the production of automotive parts was developed. Each unit of the assembly is a catalogue item. The feed parallel with the 3-hp, 3600-rpm superprecision spindle is assembled with a right-angle micrometer dial handwheel feed. Any position required for the grinding wheel on a 360-degree

circle is instantly obtained through the graduated swivel base mounted on a heavy-duty feed base.

Conversions of existing machines for use with this manufacturer's electrolytic spindles frequently must include a controlled work-feed table made possible by simply installing a compound table or feed base, as illustrated in the lower view. Although the illustration is of an 18-inch longitudinal travel unit powered by a variable-speed 0- to 220-rpm motorized transmission drive, various increments of power travel are available up to 50 inches. The micrometer dial cross-feed is available with any length of movement required. Power feeds have nonmetallic ways, gravity oil lubrication, and are typical of all units as illustrated. Accordion way protectors are available.

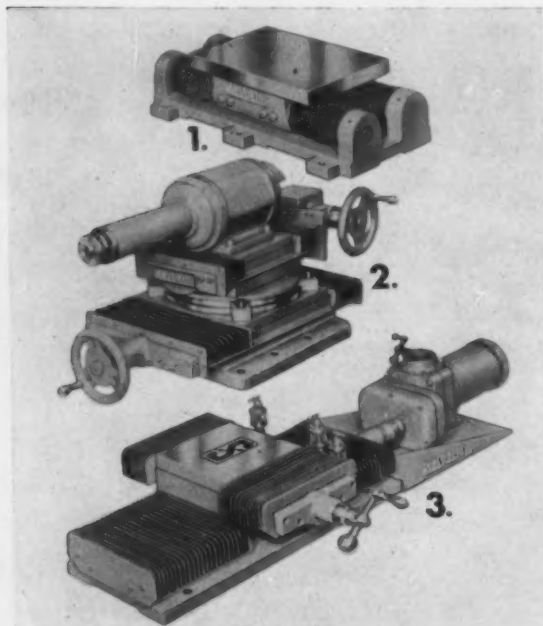
Circle 590 on Readers' Service Card

Open-Back Inclinable Press

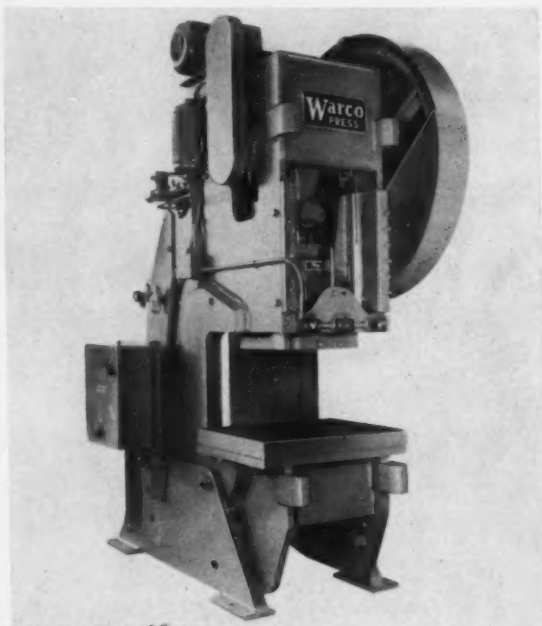
The Federal-Warco Division, McKay Machine Co., Warren, Ohio, is building its standard Warco open-back inclinable presses in single-gear or flywheel types, but can build these machines with double-back gearing and in capacities ranging from 40 to 200 tons. The flywheel type is built in sizes from 40 to 75 tons. These presses are of welded steel construction, and the stroke can be made any length to suit the customer's requirements. They are especially adapted for such operations as blanking, forming, bending, and shallow-draw work.

For drawing operations the press may be equipped with die cushion in the press bed. The gap type frame is arranged so that the press can be inclined. This frame provides unobstructed access to the die area from three sides of the press. The finished parts may be removed from the dies by gravity or an air jet and directed through an opening in the back of the press to a receptacle. All presses are equipped with pneumatic friction clutch and brake unit.

Circle 591 on Readers' Service Card



Typical units from line of Building-Block equipment available from Standard Electrical Tool Co.



Warco 100-ton open-back inclinable press adapted for blanking, forming, bending, and drawing

New

IN-LINE LOADER SERVES RED RING SHAVING MACHINES ON AUTOMATED LINES

This new Red Ring Loader automatically conducts work gear units straight through the shaving station of an automated machine line in the simplest, most direct way.



4 PRINCIPAL ADVANTAGES

- ★ Accommodates larger diameter work gears
- ★ Eliminates the need to change direction of work flow to and from shaving
- ★ Feeds by gravity from either side
- ★ Suitable for all Red Ring Model GCU Machines

UNRESTRICTED CHOICE

When automatic feed and discharge from the front of the Shaving Machine is more desirable, the conventional Red Ring Rocker type loader is also available.



SPUR AND HELICAL GEAR SPECIALISTS
ORIGINATORS OF ROTARY SHAVING,
GEAR HONING AND ELLIPTICAL

Contact our local representative for complete details.

NATIONAL BROACH & MACHINE CO.

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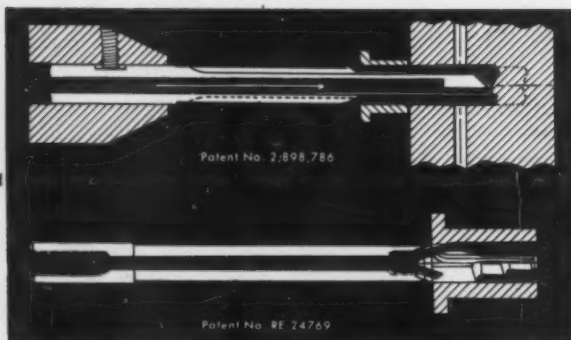
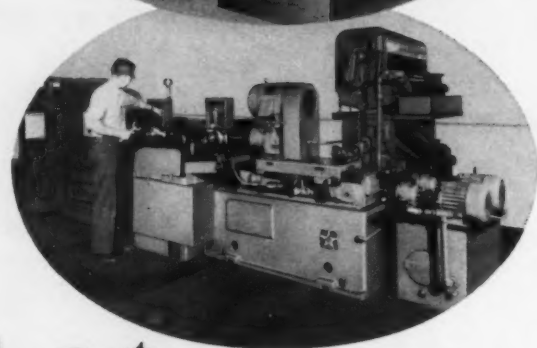
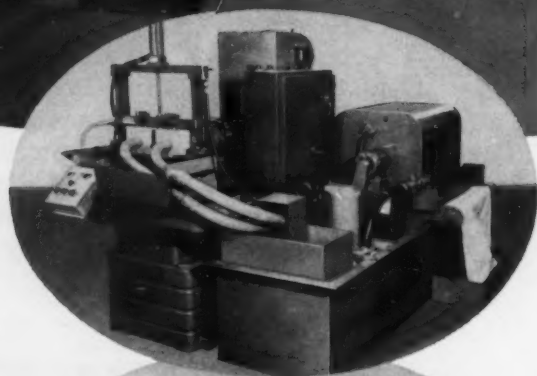
★ SAVE EQUIPMENT DOLLARS
★ IMPROVE WORK QUALITY
★ SAVE PRODUCTION TIME

Star's master machinists will rebuild your present machine, (or one from our stock), equip it with high-efficiency Starbore tooling, and you will have the finest hole finishing equipment available. You get unexcelled, one operation precision hole finishing and a new machinery guarantee at a fraction of new equipment cost.

Let us give you an estimate.

Starbore TOOLING GIVES YOU

- Longer tool life
- Reduced number of operations
- Closer tolerance
- Improved finish



Starbore CENTER-CUT TYPE DRILL

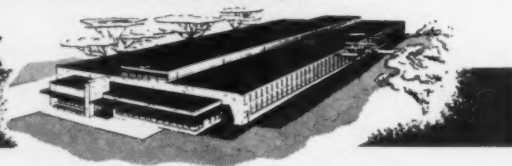
Designed for smooth precision drilling of blind or intersecting holes, cored areas, laminated sections or recesses. Off-center pressurized coolant port produces no pin.

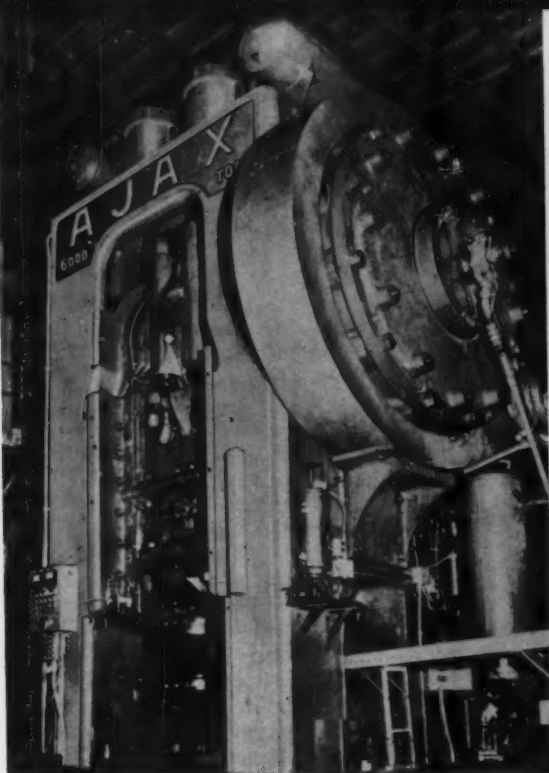
Starbore TWO-FLUTE, MULTI-DIAMETER REAMER

In many cases these high precision tools can ream a die cast or rough-cored hole to a highly accurate, finished, stepped hole in one operation. Note ample purging action of pressurized coolant.

Write for detailed literature on Starbore gun drilling tools.

Star Cutter Company





Gigantic high-speed friction-drive mechanical forging press built by the Ajax Mfg. Co.



Welding equipment developed for thin-gage metal announced by Westinghouse

Mammoth High-Speed Mechanical Forging Press

A 6000-ton high-speed mechanical forging press built by Ajax Mfg. Co., Cleveland, Ohio, has begun the production of large-diameter axle gear and pinion forgings at the Marion, Ohio, plant of the Eaton Mfg. Corporation. This mammoth press produces 18 1/2-inch diameter, 130-pound ring gears from SAE 8620 and 4718 steel in only three strokes—instead of twenty-five to forty-five strokes required by the large drop-hammers previously employed. No intermediate pre-heat is needed. The eccentric-driven ram is powered by a 400-hp motor. The press has an 18-inch stroke and operates at the rate of thirty-five strokes per minute.

The working area is 70 inches, right to left; 74 inches, front to back; and is open for through feed by mechanical manipulators. The weight of the press is 930,000 pounds, the cast-steel frame alone weighing 470,000 pounds. The 16-foot long drive-shaft weighs 50,000 pounds and is 4 feet in diameter at the eccentric.

Despite its enormous size—looming 24 feet above the floor—this forging press has a smooth, shock-free stroke, without noise or impact to damage brittle linings in nearby furnaces or disturb precision machinery. The dies need no massive body to absorb

hammer impact—or dissipate heat from slow operation—and are built up from inserts locked into the bolster plate.

A giant-size safety friction drive in the flywheel hub is calibrated to slip at a predetermined torque, protecting the press from overloads by cold stock, oversize, or misplaced blanks.

Circle 592 on Readers' Service Card

Westinghouse Welding System and Equipment for Thin-Gage Metal

A unique concept in welding thin-gage materials that promises exceptional speed and versatility at low cost has been announced by the Westinghouse Electric Corporation, Westing-Arc Department, Buffalo, N. Y. Called the Westing-Arc SA-200 system, the new welding equipment package includes a 200-ampere silicon diode rectifier power source, a compact wire drive system with wide feed range, and a new concept in straight-through torches. The power source, a Westing-Arc Type RCV welder, has features that make it unusually well-fitted for fine electrode-wire production-

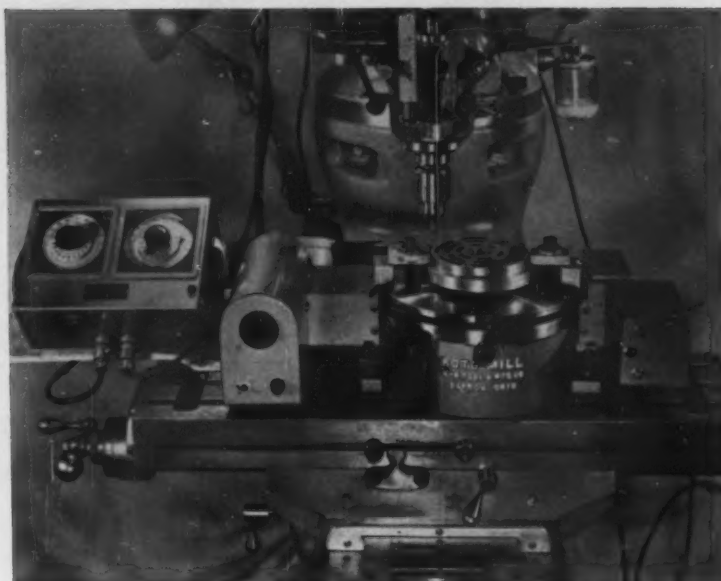
welding of thin-gage metal.

The wire drive system has a range of 90 to 424 ipm with standard gearing, and can be modified to provide speeds up to 1170 ipm. Both drive rolls operate to provide more positive drive feed. A micrometer assures wire-feed control adjustments formerly impossible.

The straight-through torch is said to be the lightest, coolest, and most easily maneuvered welding tool available. The weight of the torch itself is 22 ounces, and it will accommodate wire sizes in mild or stainless steel from 0.025 to 0.047 inch in diameter.

Circle 593 on Readers' Service Card

Roto Mill Electronic Index-Table



M-M 800 Roto Mill index-table for spacing of hole patterns

"Micro-Turn" High-Speed Precision Lathe

An improved-model "Micro-Turn" high-speed lathe for tool-making and precision production work, featuring infinitely variable spindle speeds with constant horsepower, has been introduced by the Nebel Machine Tool Corporation, Cincinnati, Ohio. Manufactured to complete A.S.A. standards, this lathe combines a unique mechanical speed-variator drive unit with an exclusive coaxial spindle design. This arrangement provides an infinite selection of spindle speeds throughout a continuous range of 43 to 3500 rpm. Constant, full-drive horsepower is delivered through the entire range, with output speed maintained within 2/10 of 1 per cent. Thus, maximum torque is provided at the lowest speeds for heavy cutting, plus precision balance and minimum vibration at the high speeds assuring ultrafine finish. A built-in torque responsive mechanism in the main drive unit prevents slippage under starting or shock loads.

For maximum turning efficiency there are two speed ranges. In the low-speed range, up to 400 rpm, the Micro-Turn operates through a planetary gear unit. In the high-speed range, above 400 rpm,

headstock coaxial sections lock into a single unit, and the lathe operates without gearing through matched multiple V-belts directly from main drive to spindle, assuring positive torque and minimum vibration.

A totally enclosed pressure-lubricated gear-box provides sixty thread and sixty feed changes. The standard thread range from 4 to 240 threads per inch includes standard pipe-size threads of 11 1/2 and 27. Standard feeds

An M-M 800 Roto Mill electronic index-table designed for automatic spacing of hole patterns in degree, 1/2-degree, or 1/10-degree increments is announced by the M & M Tool & Mfg. Co., Dayton, Ohio. This index-table can also be used for programming a part that requires milling of slots. By use of a 15-inch program plate, the M-M 800 can program uneven indexes, and eliminate errors that sometimes occur when hand indexing.

The table can be easily programmed to suit the specific application. It can be used in a vertical or horizontal position and is designed for drilling, boring, jig boring, checking, milling, spacing, and many other applications. Power is provided by a 110-volt, 60-cycle motor. A special slip clutch is furnished for hand operation if needed.

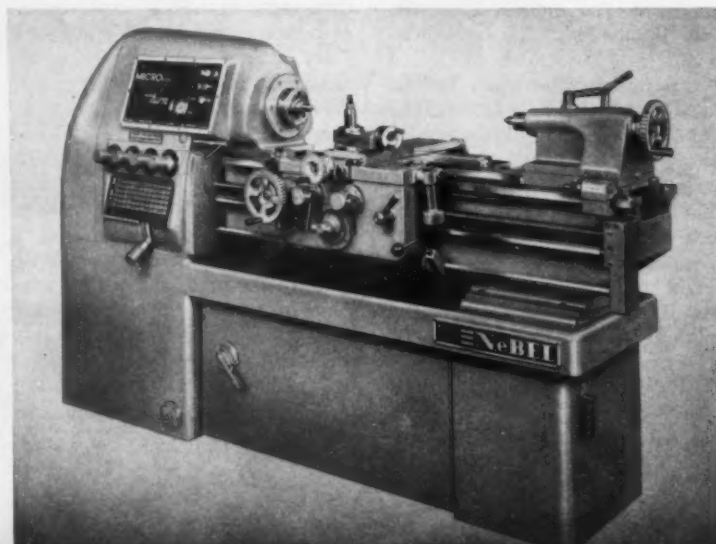
Circle 594 on Readers' Service Card

range from 0.0005 to 0.0337 ipr of spindle. An exclusive feed converter, located in the apron, provides simple conversion from standard to optional feed ranges without affecting standard thread changes.

Other outstanding features include double-wall, one-piece, totally enclosed pressure-lubricated apron, carriage, and cross-slide with automatic, fail-safe lubrication; coolant system with automatic-manual selection control; and antifriction bearings throughout.

Circle 595 on Readers' Service Card

Nebel Micro-Turn high-precision toolmaking and production lathe





Not just four Presses—

**A Complete Production System
Erected and Proved *Before Delivery***

The way one major manufacturer produces automotive wheel discs may be a clue for you. These four Clearing presses comprise a complete production unit. Stock feed is automatic. Intra-station parts movement is automatic. All operations are coordinated and supervised by an electrical control system that does everything except turn itself on and off.

The automatic feed is designed so that it can adjust for size changes. Should product designs change radically, the presses may be used in another, completely different arrangement, or they may be used



Closeup of the massive automatic feed drive for the Clearing production system above.

as individual machines.

Clearing takes the guesswork out of the job by engineering and building the complete setup. It's then tested (as above) on our assembly floor. That way, we can eliminate a lot of bugs before the job leaves our shop. You can be **confident** when you place your order with Clearing.

Want more details? We'll be glad to discuss a better press production setup for your company. Whether you need a small O.B.I. or a line of straight side mechanical or hydraulic presses, call on Clearing.

usi Clearing

DIV. of U.S. INDUSTRIES, Inc. 6499 W. 65th Street, Chicago 38, Illinois
Telephone PO 7-8700



MILLING

THROW-AWAYS or BRAZED?

*Wesson can help make
it easier to decide . .*



MILLING

Compare these two jobs. One called for a Wesson Rigidcut. The other for a Wesson throw-away insert cutter. Why? Finish milling cylinder block top and faces (left) called for 9 in. cutters at 80 ipm. feed and 400 fpm. cutting speed. That's almost $\frac{1}{2}$ in. feed per revolution and calls for all the blades you can get to keep down chip load. This Wesson Rigidcut mill uses 38 blades . . . better than 4 per inch of diameter. You couldn't do that with a T-A cutter or almost any other cutter.

For the crankshaft job (above) Wesson recommended T-A cutters. While production was satisfactory with another type, grinding costs and downtime were high. The switch to T-A's dropped tool costs from over \$10,500 to less than \$4,400 for the same output per year. Less downtime was a 'plus'.



You can now quickly adjust throw-away insert and other types of boring tools to tenths of a thousandth (in a range of up to $\frac{1}{4}$ ") using a vernier scale on the boring bar. Available in standard and special boring tools. Ask for Bulletin #B-1259.

WHICH FOR MILLING . . .

Wesson makes milling cutters—with both throw-away and brazed inserts. Your Wesson field engineer is a "pro".

Ask him to study your high-tool-cost operations and tell you which cutter type he recommends . . . and why. Wesson tools are guaranteed to perform as specified.

He can do this for 4 reasons:

1. He is a real pro on boring, milling and turning.
2. He'll study your jobs thoroughly right in your plant.
3. He lives with the job and makes it work.
4. He is backed by 4 specialized tool plants, plus our own metals plant, and basic research, application research and tool engineering staffs.

His on-the-job analysis costs you nothing and can point the way to major savings YOU can make.

Ask him to call on you soon.



A new 8-page booklet from Wesson analyzes all the factors involved in picking the best type of tool—throw-away, brazed or on-end type for turning operations. Ask for your copy today.



WESSON CORPORATION 1220 WOODWARD HEIGHTS BLVD., FERNDALE 20, MICH.

PLANTS IN: LEXINGTON, KENTUCKY • FERNDALE AND BRIGHTON, MICHIGAN

EVER SIT ON A CONCRETE BENCH

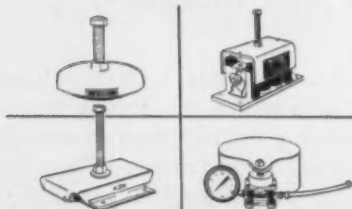
WITHOUT A CUSHION?

The longer you sat on it . . . the more you wished you had a cushion, didn't you? And remember how you felt every little vibration from those passing trucks?


Precision manufacturing equipment feels vibration too, but it can't get up and move away very easily — particularly when it's lagged down to a concrete foundation! Machine tools simply show their discomfort by higher reject rates or continuous maintenance problems.

What's the answer?..SERVA-LEVL® Mounts . . . a new concept that floats precision machinery on columns of air! Even ultra-precision, numerically controlled machines no longer require special, costly foundations. And, SERVA-LEVL Mounts *automatically* keep your machines *absolutely level* . . . as precise as 50 millionths of an inch per foot under the shifting load conditions of a long-bedded lathe.

If your machine tools are bothered by vibration, or if you want layout flexibility, no-shim leveling, reduced maintenance, and cost reduction . . . write for your copy of Bulletin 60-04B, "Practical Considerations When Installing Machinery."



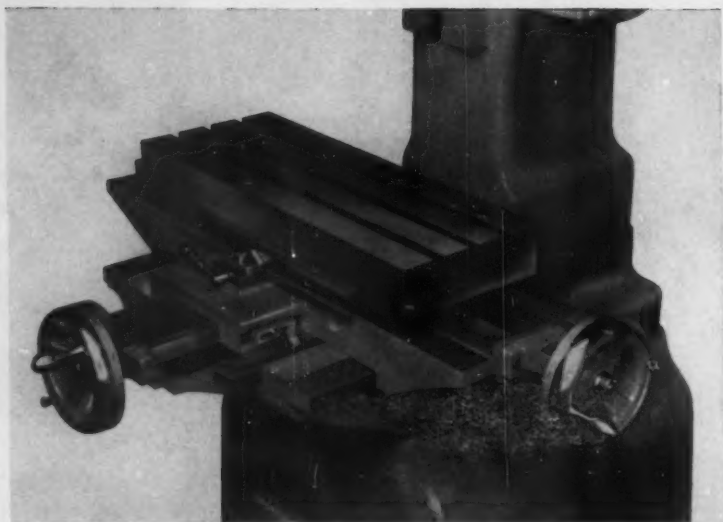
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SHOCK • VIBRATION • MACHINE EFFICIENCY
Division of Barry Wright Corporation 

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1400 FLOWER ST., GLENDALE, CALIF.

Circle page number on Readers' Service Card

206



Improved table and saddle of Linley Model 1A jig-boring machine

Linley New Model Jig-Boring Machine

A Model 1A jig-boring machine incorporating many important design features not found on preceding models has been announced by Linley Bros. Co., Bridgeport, Conn. The entire table and saddle assembly has been greatly increased in size and weight to give more rigidity and to improve balance characteristics through less lateral change in center of gravity — thus insuring extreme accuracy of operation.

Square-edged ways, positive no-shift table and saddle locks, 3/8-inch standard table T-slots, and easy individual gib adjustment

with Helicoil self-locking type inserts are some of the other features of the jig borer.

Adding to the machine's ease of operation are reference scales with large legible numbers and movable pointers which allow positioning without counting handwheel turns. Table size and movement are 7 by 17 1/2 inches and 6 1/2 by 10 inches, respectively, similar to the earlier Model 1. Other specifications and accessories are the same as for the Model 1 Linley jig-boring machine.

Circle 596 on Readers' Service Card

Sweco Vibro-Energy Finishing Mills

High-efficiency polishing and deburring of metal, plastic, and ceramic parts by means of three-dimensional, high-frequency, low-amplitude vibration were demonstrated by the Southwestern Engineering Co., Vibro-Equipment Division, Los Angeles, Calif., at the recent Western Metal Exposition in Los Angeles. One of these finishing mills, which produces spiral orbital motion of parts and polishing media, is shown in the illustration. Vibro-Energy finishing mills of this kind are available in three sizes having capacities of 1, 3, and 10 cubic feet.

Circle 597 on Readers' Service Card



Vibro-Energy finishing mill built by Southwestern Engineering Co.

MACHINERY, October, 1961



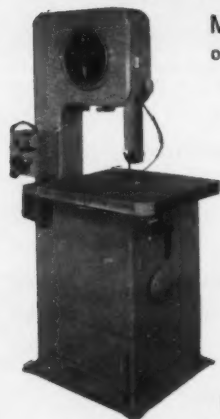
Model 2612-2H



a
DoALL
PRODUCTIVITY-
PLUS
product

Now you can buy
a 26" DoALL
machine with
hydraulic table
at a 50% saving
in price over
previously
available models

**Same throat capacity . . . same worktable
features . . . coolant system . . . same
cutting rates with Demon® HSS blades***



Model 1612-U
only **\$995⁰⁰**
(Base Machine)

**Another
DoALL bargain**

—a multipurpose Utility machine with
built-in DoALL quality and performance.
Has 16" throat and 12" thickness capacity.

Uses new Dart® blades that outcut
and outlast any other carbon steel
blades—or your money back!
Ask for demonstration.

Everything about this new DoALL model 2612-2H band
machine is almost identical to DoALL's famous 26" Contour-
matic® machine. Principal differences are in table size and
elimination of certain hydraulic controls—but the price
is 50% lower!

You get the hydraulically powered, infinitely variable feed
table that tremendously multiplies your operator's pro-
ductivity, lets him turn out more work with less effort,
whether it's a one-of-a-kind job or production run.

You get the full 26" throat capacity, the built-in coolant
system, and all of the standard equipment, including one
Demon high-speed-steel saw band that will deliver cutting
rates up to 12 square inches per minute in mild steel.

Here is a tremendous buy never before available in a genuine
DoALL power feed machine of this size and capacity—
and it has DoALL quality and performance through and
through.

Get all the facts before you buy any vertical contour sawing
machine—call DoALL today.

THE DoALL COMPANY, Des Plaines, Illinois
Serving you locally through your DoALL Sales-Service Store

* U.S. PAT. NO. 2,786,788

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MACHINE
TOOLS

Price \$10,336 Rent \$66.21
Model 2613-3 per week



Contour-matic
23 models available
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Price \$1475 Rent \$9.46
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6" x 12"



12 models available
SURFACE GRINDERS

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6 models available
POWER SAWS

CUTTING
TOOLS

DoALL 18 types
SAW BANDS
All sizes



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Shop blocks \$130
50 sets
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Price \$80
18" x 24"
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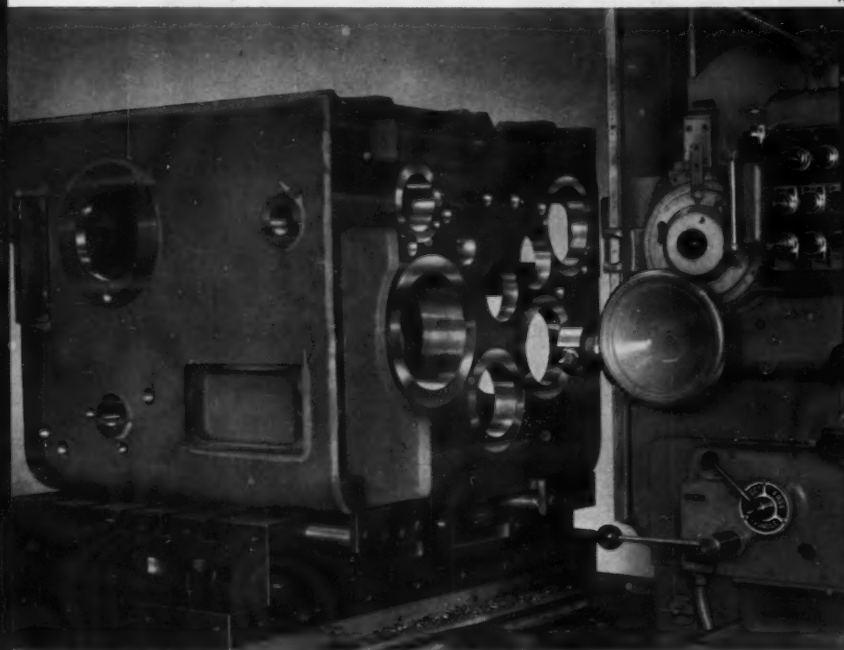


Every few days, someone from another country visits Fair Street. He may come from Asia, Australia, Canada, Europe, Latin America; any part of the Free World. And when he arrives, we display his country's flag in our lobby.

WHY DO THEY COME . . . these important industrial leaders from all over the world? They come because they are interested in finding better ways of doing things. These men must find solutions to problems raised by the need for increased accuracy

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- DeVlieg JIGMILS with Standard Controls, Diatrol and Tapac
- The Micropoint Tool Grinder
- The Microbore System of Precision Tooling

Lathe headstock rough and finish milled and bored from four sides in one setup on a 3B-48 JIGMIL. Total machining time is approximately 8 hours.

and higher productivity with readily available skills. Specifically, in the field of boring and milling, they've heard that the JIGMIL Technique and the DeVlieg concept of Precision Machining go a long way towards solving such problems. No one is ever disappointed. Every visitor, whether from overseas or local firms, is introduced to rewarding new concepts in machining. Concepts that once discovered, cannot be ignored.

WILL YOU BE THE NEXT TO VISIT FAIR STREET

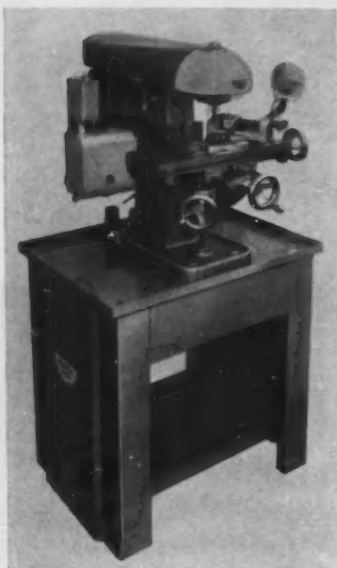


DeVlieg

SPIRAMATIC JIGMILS®

ACCURATE HOLES AND FLAT SURFACES
IN PRECISE LOCATIONS

Benchmaster Combination Mill Package Includes All Electrical Equipment

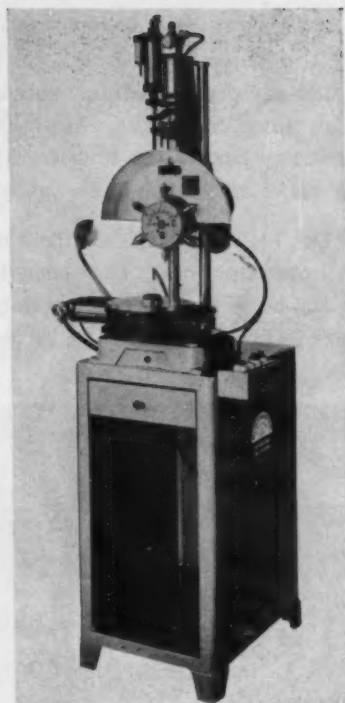


Combination horizontal and vertical mill available as package unit with electrical equipment from Benchmaster Mfg. Co.

The Benchmaster Mfg. Co., Gardena, Calif., is now marketing its combination horizontal and vertical mill as a "package" unit. Included is all electrical equipment, such as motor, machinist's light, three-phase push-button switch, forward-reverse switch, and magnetic starter. When the mill is ordered as a package unit, installation of the above units is made without charge.

This machine has a table 6 by 18 inches with a travel of 12 1/2 inches. It offers a choice of two interchangeable spindle assemblies which accommodate both vertical and horizontal milling operations on the same machine. Manual screw feed on all table motions is available, or production models can be supplied with rack-and-pinion feed on both vertical and longitudinal motions or longitudinal table travel alone. Accessories include an independent table power-feed unit, arbors, overarm support brackets, rotary tables, vices, a full line of collets, and a floor stand.

Circle 593 on Readers' Service Card



Burgmaster turret drill equipped for deep-hole drilling

Burgmaster Turret Drills

A reciprocating feed arrangement for deep-hole drilling is now available as optional equipment on all Burgmaster automatic bench-model turret drilling machines, according to an announcement of the Small Tool Division, Burgmaster Corporation, Gardena, Calif. The new feed arrangement provides for drilling to a certain depth, retracting to the top of the work-piece, rapid traversing down to the previous stopping point of the drill, drilling another increment (as desired), retracting to the top of the work to clear chips, and then repeating the cycle until the final depth is reached. At this point the drill is rapid-traversed to the top of the stroke, indexed to the next tool, and the machining cycle is continued.

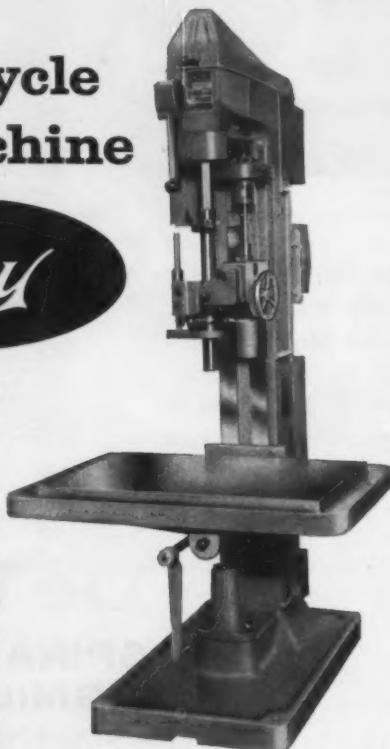
An electronic device is set to control the depth for each stroke and to withdraw the drill any number of times to suit the work being handled. Extremely small holes can be drilled with the new reciprocating feed attachment, which permits a range of speeds from 350 to 21,000 rpm.

Circle 599 on Readers' Service Card

automatic cycle drilling machine

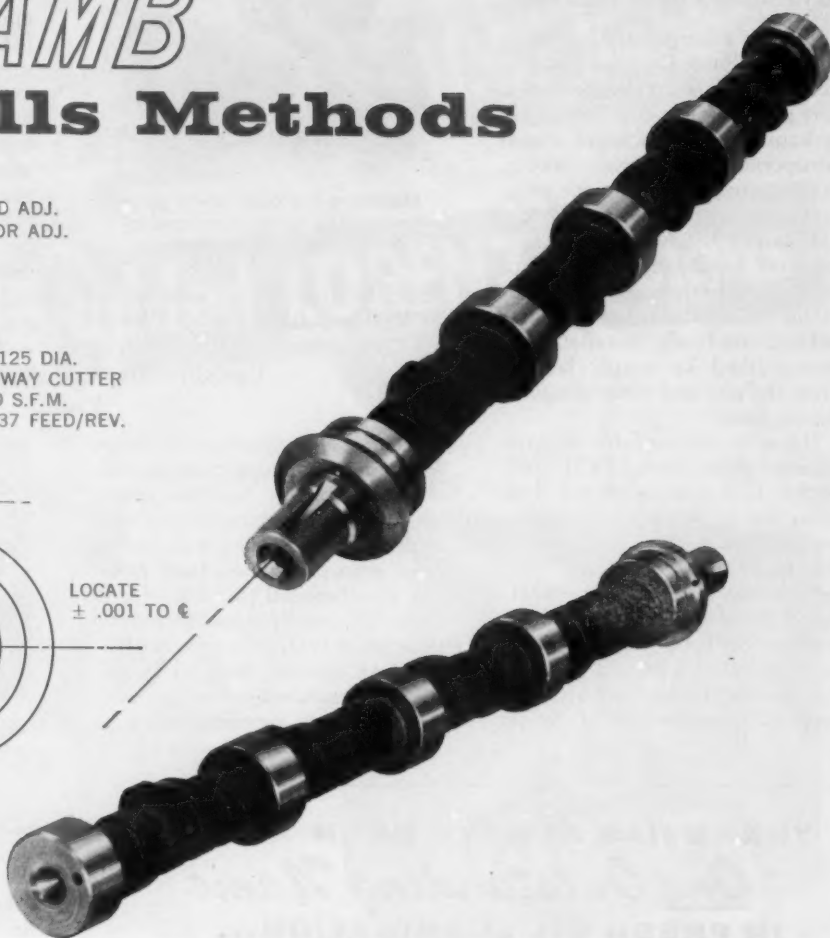
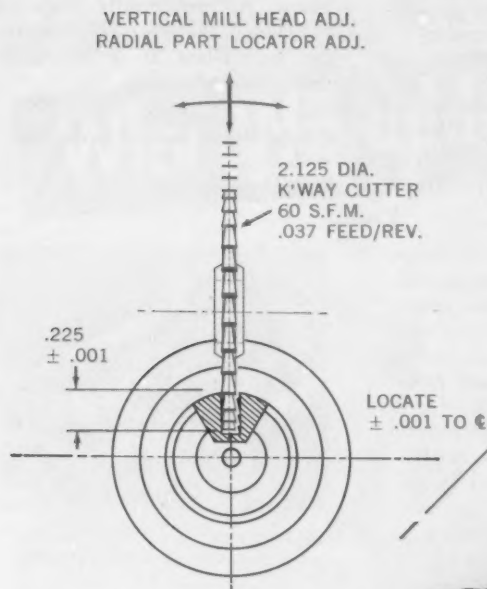


You can chop your time costs with automatic set-ups on this new Avey machine, and still take advantage of the low cost and flexibility of a standard unit. Adjustable rapid power traverse, feed, and rapid return of the spindle permit automatic transfer or rotary index fixturing. You also get adjustable feeds, speeds, table travel, head travel, and Avey's precision spindle. Morse Taper 2, 3, or 4; single or multiple spindles 1 to 5 hp. Write or phone for data. Avey, Box 1264, Cincinnati 1, Ohio.



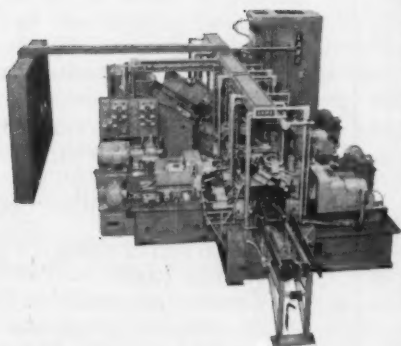
LAMB

Sells Methods



**C.I. camshafts for 6 and 8 cylinder engines
mill, drill, tap and probe 2 at-a-time.**

Mill heads on this 7-station machine are adjustable for precise depth and centrality. Adjustable part locators provide desired radial position for milling the timing gear key slot—the qualifying operation for all subsequent machining. These adjustments will permit future changes in engine timing. Lamb special attention to manufacturing methods will be reflected as quality and economy in your workpiece.



9739

F. JOS



CO.

5663 E. NINE MILE ROAD • DETROIT 34, MICHIGAN

Since 1914 Engineers and Builders of Special Machines and Automation Equipment
MACHINERY, October, 1961

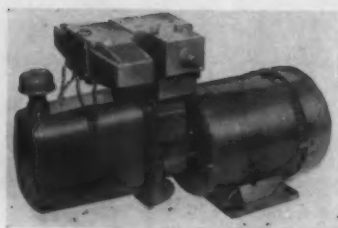
For more data, circle this page number on Readers' Service Card.

211

Vickers Motorized Hydraulic Power Packages

Vickers Incorporated, division of Sperry Rand Corporation, Detroit, Mich., has brought out a new series of low-cost motorized hydraulic power packages which incorporate the pump, motor, valving, and reservoir in one compact assembly. These power packages can be used in virtually any machine application, including small press brakes, paper cutters, baling presses, tube benders, and welding machines. Installation is accomplished by simply bolting down the unit and connecting hydraulic lines.

The units are available in three different series. Series PKSI, with outputs to 8 gpm, is offered with either one or two solenoid valves. An overload relief valve, adjustable to 1500 psi, is integral with the adapter block. Series PKMI, also with outputs to 8 gpm, is available with up to three manually operated valves. Units are equipped with nonadjustable tamper-proof overload relief valve



Motorized hydraulic power package of new series introduced by Vickers Incorporated

(available in 250-psi increments to 1500 psi). Basic models (Series

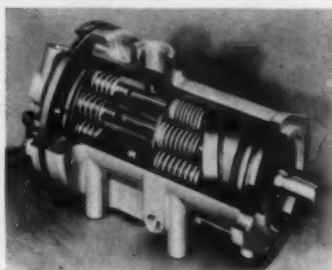
PKM6) without control valves are available in outputs to 5 gpm. An adjustable overload relief valve is provided for pressures up to 1500 psi.

Electric motors are offered in five sizes from 1 to 5 hp at 1800 rpm—either 220/440-volt, three-phase, or 115/230-volt, single-phase. All are totally enclosed, fan-cooled, 55-degree C. heat rise and have Class "B" insulation for maximum reliability.

Circle 600 on Readers' Service Card

Variable-Displacement Hydraulic Pump

A variable-displacement hydraulic pump claiming exceptional control versatility, high maximum speed and pressure capability, and high over-all efficiency is available on a mass-production basis from the Weatherhead Co., Cleveland, Ohio. This axial piston type pump, designated WO7, incorporates JIC and SAE specifications for industrial and mobile applications and meets military specifications.



Cutaway of Weatherhead variable-displacement hydraulic pump

THERE HAS ALWAYS BEEN

One Outstanding Name

IN FRESH OIL LUBRICATION...

MADISON-KIPP

Fresh Oil Lubrication is automatic, closely measured, constantly fed new oil under pressure for each friction surface to which it is applied.

Machine Tools, Compressors and special machines of all kinds have been kept in top condition for 20 or 30 years or more when equipped with one of 6 models of Madison-Kipp Lubricators.



The Model OL—one of the 6 Models of Madison-Kipp Lubricators.

kipp

MADISON-KIPP CORPORATION
203 WAUBESA STREET • MADISON 10, WIS., U.S.A.

Skilled in Die Casting Mechanics • Experienced in Lubrication Engineering • Originators of Really High Speed Air Tools

Control of the pump is by means of a balanced cylinder block and wobble type reaction plate which virtually eliminates pumping forces from the displacement-changing mechanism. Reaction pistons serve to balance completely the hydraulic forces exerted on the cylinder block during pumping. The cylinder block is nonrotating, thus eliminating centrifugal forces acting on reciprocating components and allowing a substantial increase in maximum speed potential. Drive-shaft and cam are the only two rotating parts. The pump can operate continuously under a no-flow condition while maintaining full system pressure without additional power.

Nominal output rating is 9 gpm at 3600 rpm (continuous) at 3000 psi. Controls are available from 250 to 3000 psi. Speed range of the pump is from 450 to 4500 rpm. Four alternate displacement controls are available: internal pressure compensation, manual hand-wheel control, manual lever control, and servo control.

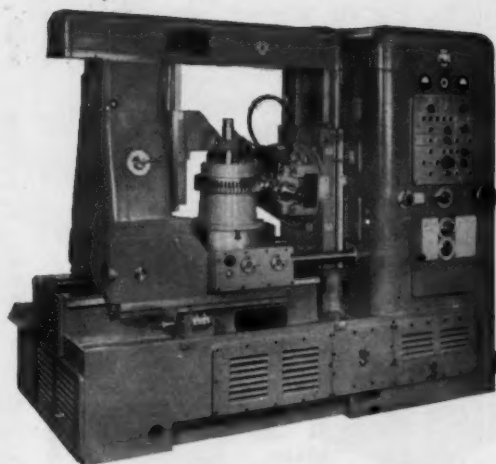
Circle 601 on Readers' Service Card

Why EUROPE wanted U.S. hobbers

Why WE added LORENZ designs
(GERMAN)



Michigan 1458B hobbers are available for gears up to 12" OD and 4 $\frac{1}{4}$ " face width. Ask for Bulletin #1458-61.



Michigan-Lorenz hobbers are available in 3 styles for gears up to 24" capacity. Ask for Bulletin #ML-61.

IN EUROPE, industry has extensively switched to mass production methods and equipment. This calls for machines that will stand the gaff day after day in continuous production. One major company decided to test all hobbers . . . European and American. The MICHIGAN 1458B hobber was found the ideal machine despite higher cost than for European machines. It gave top output, high accuracy, minimum downtime, freedom from service troubles. Since then, Europe has been a repeat buyer of 1458B hobbers.

If you want to cut your production hobbing costs, you too will find the 1458B the machine that can really do it.

IN THE UNITED STATES, gear producers who needed more versatility with high accuracy and low cost have eyed European hobbers for some time. Michigan Tool Company joined them and found that the design of the German Lorenz line of hobbers came closest to meeting U.S. needs. An engineering arrangement was made and today, as the MICHIGAN-LORENZ line, these versatile hobbers are available as American-built machines produced by Michigan Tool Company.

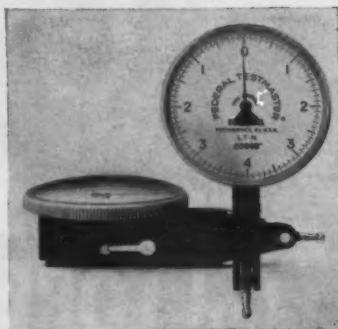
If you need top versatility with accuracy and ruggedness—you too will find MICHIGAN-LORENZ hobbers (and shapers) will cut your costs.



MICHIGAN TOOL COMPANY, 7171 E. McNICHOLS RD., DETROIT 12, MICHIGAN

Supersensitive Test Indicators

One of a new series of test indicators, with 40 per cent less gaging tension and 25 per cent less friction than previous models, announced by Federal Products Corporation, Providence, R. I. These supersensitive Testmasters include both large (1 1/2-inch diameter) and regular 1-inch dial models. Inherent accuracy and sensitivity of this series permit the inclusion of a model graduated in 50 millionths of an inch. This sen-



sitivity is achieved primarily by a more responsive internal mechanism, plus the introduction of a new counterbalanced indicating hand and full-jeweled bearings throughout. Mounting dovetails of the new supersensitive series are cast integrally with the case to prevent any chance of their becoming loose while the indicator is in use.

Circle 602 on Readers' Service Card

Transistorized Sound-Level Meter

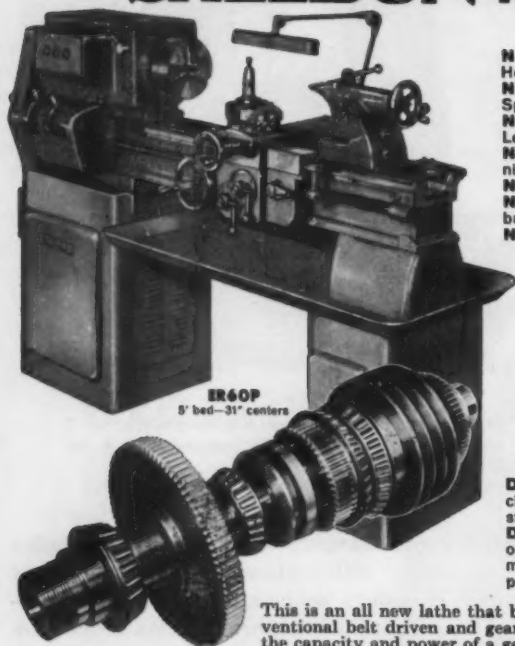
Fully transistorized, battery-operated sound-level meter weighing only 4 pounds with patented, high-impedance input introduced by the Korfund Co., Inc., Long Island City, N. Y. This Type



1400E self-contained acoustical instrument features exceptional accuracy, stability, and sensitivity, giving direct readings of sound-pressure levels over the entire audio range from 24 to 140 decibels on its 5-inch wide meter dial. Its transistors are said to virtually eliminate microphonics, and provide superior calibration and amplifier stability. The instrument is powered by three dry cells, good for sixty operational hours, or by an external 115-230 volt, 60-cycle source.

Circle 603 on Readers' Service Card

Both NEW and DIFFERENT SHELDON 15" PRECISION LATHES



Send in Coupon for full information

NEW
New. Revolutionary double-box Headstock (Pat. Pend.)
New. "WORK-HOLDING ONLY" Spindle.
New. Single-Shift Back Gear Lever on Headstock.
New. Headstock and Apron running in oil.
New. 1 1/2" Hole through Spindle.
New. 60-pitch Gear Box with built-in Lead Screw Reverse.
New. Amazing LOW PRICE.

DIFFERENT
Different. Spindle rigidly held in two large "Zero Precision tapered roller bearings arranged in box-type design.
Different. Electrical switches and push-button stations fully enclosed in built-in well in headstock.
Different. Two independent clutches in apron for selecting power feeds.
Different. Cam-action tailstock clamp for rapid release and instant locking of tailstock.
Different. Triple, cogged, V-belt outboard drive—eliminates intermediate shafts—delivers more power to spindle.

This is an all new lathe that bridges the gap between conventional belt driven and geared head lathes. It combines the capacity and power of a geared head with the economy and flexibility of a belt driven lathe. Available with 5', 6' and 8' bed lengths providing 31", 42" and 66" center distances.

SHELDON MACHINE CO., INC. 4246 No. Knox Ave., Chicago 41, U.S.A.

Gentlemen: Please send me information on items checked.

- ☐ The NEW and DIFFERENT SHELDON 15" Lathes
☐ Sheldon ☐ 10" ☐ 11" ☐ 13" Lathes
☐ 11" and 13" Variable Speed Lathes
☐ High Speed Turret Lathes
☐ Sebastian 13" and 15" Geared Head Lathes
☐ Horizontal Milling Machine
☐ Sheldon 12" Shaper
☐ Name of Local Dealer
☐ Have Representative Call

Name Title
Company Name
Street Address ☐ Company ☐ Home
City State



T-J CUTTERS

**Designed To Do *More* Jobs . . . Produce *More* Work
 . . . Save *More* Production Time and Cost**

Proved, definitely, as the cutting tool for the die-sinking industry, T-J now offers an expanded cutter line for the precision milling of today's high speed, high production manufacturing. The new line has been designed to do more, as well as add to individual cutter life. Cutters feature a high helix angle, double back-off, right or left hand spiral, and flats on the shanks for set screw type chucks. Write today for Catalog No. 259 and complete details to The Tomkins-Johnson Co., 2425 W. Michigan Ave., Jackson, Mich.

Representation in all major areas, including Canada.



TOMKINS - JOHNSON

RIVITORS...AIR AND HYDRAULIC CYLINDERS...CUTTERS...CLINCHORS

Worm and Gear Reduction Unit

Double-reduction speed reducer available in a wide selection of ratios ranging between approximately 25 to 1 and 3600 to 1 from Cleveland Worm & Gear Division, Eaton Mfg. Co., Cleveland, Ohio. Made in seven sizes with torque capacities ranging approximately between 22,700 and 145,000 inch-pounds. These reductions are obtained by a worm and gear mounted at a 90-degree angle.



The primary and secondary reduction housings are parallel to one another. The high-speed housing is cooled to AGMA standards by an aluminum or plastic fan of unique design.

Circle 604 on Readers' Service Card

Ratchet Pliers for Applying or Removing Retaining Rings

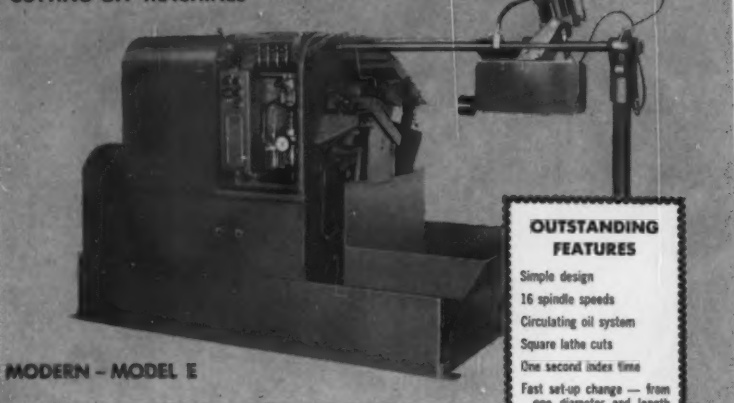
One of two new heavy-duty retaining-ring pliers introduced by the Truarc Retaining Rings Division of Waldes Kohinoor, Inc., Long Island City, N. Y. The new tools are known as the Nos. 5R and 6R double-ratchet pliers. The



5R pliers are designed to compress internal type rings for assembly or disassembly in a bore or housing, while the 6R pliers expand external rings for installation or removal over a shaft. The ratchet's locking action permits the operator to install or remove a ring without maintaining constant pressure on the handles, and also serves as a safety device which prevents the ring from springing loose accidentally.

Circle 605 on Readers' Service Card

HIGH SPEED, AUTOMATIC CUTTING-OFF MACHINES



MODERN - MODEL E

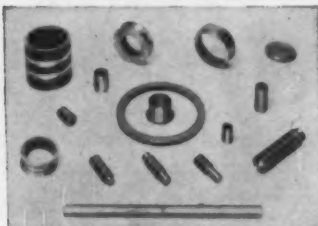
Increase production, lower costs and cut any material that can be turned — bar stock up to 3" O. D. — tubing up to 8" O. D., to lengths from a fraction of an inch to several feet, with micrometer accuracy. Ideal for use with carbide tools.

We also engineer and build machines — using the same bodies and spindles — for such operations as trimming ends of drawn shells and filler caps. Send prints for quotes.

OUTSTANDING FEATURES

- Simple design
- 16 spindle speeds
- Circulating oil system
- Square lathe cuts
- One second index time
- Fast set-up change — from one diameter and length to another. Any tool can be changed without disturbing others.
- All cams, adjustments and working parts for cross slide are outside for quick, easy adjustment.
- Chip pan slides out, for easy dumping.
- Power, speed and rigidity for cast alloy and carbide blades.
- Special spindle bearing takes all collet thrust. No thrust on main taper roller spindle bearings.

Catalog and production figures mailed on request.



We can furnish special tooling to meet your requirements — to cut-off, form, groove, flange and chamfer in a single operation, at a high rate of speed. Send prints.



MODERN MACHINE TOOL COMPANY

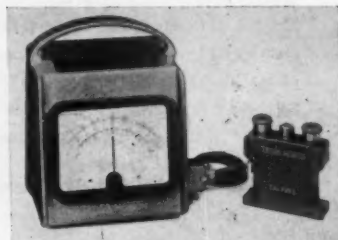
2005 Losey Street • Jackson, Michigan



FREE TRIAL OFFER. Safe, positive, fast set-ups. The Modern Safety Drill Table handles odd, irregular shapes without V-blocks, clamps or parallels. Ideal for maintenance work. Guaranteed to save its cost in labor alone every 6 months. Sizes from 8" to 27½" dia. Try it at our expense. No obligation.

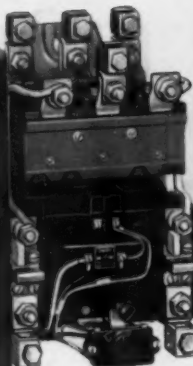
Long-Range Level-Checking Instrument

Talyvel electronic level introduced by Engis Equipment Co., division of Engineering & Scientific



Instrumentation, Chicago, Ill. This is a new type of precision instrument in which the standard bubble is replaced by a pendulum and

**You cannot afford to ignore
the New Allen-Bradley
BULLETIN 709 Starter Line**



SIZE 00
1½ HP, 220 V
2 HP, 440-550 V

SIZE 0
3 HP, 220 V
5 HP, 440-550 V

SIZE 1
7½ HP, 220 V
10 HP, 440-550 V

SIZE 2
15 HP, 220 V
25 HP, 440-550 V

SIZE 3
30 HP, 220 V
50 HP, 440-550 V

SIZE 4
50 HP, 220 V
100 HP, 440-550 V

SIZE 5
100 HP, 220 V
200 HP, 440-550 V

They OUTPERFORM and OUTLAST ALL Others

These new Allen-Bradley starters bring you the greatest advance in reliability and life in all motor control history. Also, they possess a compactness that's almost unbelievable—especially in the higher ratings.

The new Bulletin 709 solenoid starters feature a patented, high-efficiency magnet, which is cushioned to reduce shock and wear. Contacts are of weld-resistant cadmium oxide silver. All coils are "pressure

molded" for protection against physical damage and destructive atmospheres. The two or three solderpot overload relays are trip-free and tamperproof. Brooks Stevens, famous industrial designer, has given the new enclosures a styling that adds "eye appeal" to every installation. To get full details, contained in Publication 6100, please write today to: Allen-Bradley Co., 1316 S. Second Street, Milwaukee 4, Wisconsin.



SIZE 00 NOW AVAILABLE

Provides the same long life and reliability as others in the Bulletin 709 family. Rated 1½ HP, 220 V; 2 HP, 440-550 V.

15-61-MR

ALLEN-BRADLEY

Member of NEMA

**QUALITY
MOTOR CONTROL**

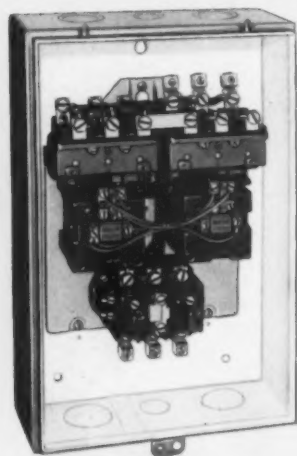
Here Your Motor Starter Dollar Buys **MORE OF THE QUALITIES YOU NEED**

Where else could you possibly obtain—in one complete line—all of the desirable features of the ideal motor control...

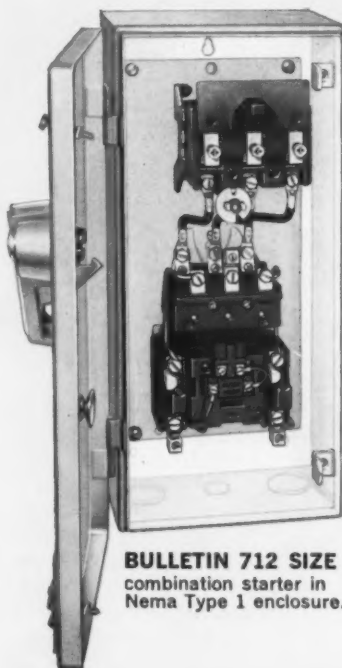
- | | |
|--------------------------------------|---|
| 1. Smaller size | 6. Simpler installation |
| 2. Greater reliability | 7. Complete accessibility |
| 3. Remarkable switching capacity | 8. Beautiful appearance—either open or enclosed |
| 4. Longer life | 9. Surprising light weight |
| 5. Conscientious overload protection | |

The heart of this new line of magnetic motor starters is the unique solenoid contactor. While it retains the famous A-B one-moving-part principle, it is completely new and far more efficient. This fact is reflected in reduced dimensions for all of these controls. Yet, this contactor design will perform reliably for many more millions of trouble free operations.

The new enclosures are very "eye appealing." When the open type starters are assembled into special panels, their neatness and compactness will delight the designers. Full details are in Publication 6100. Please write: Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.



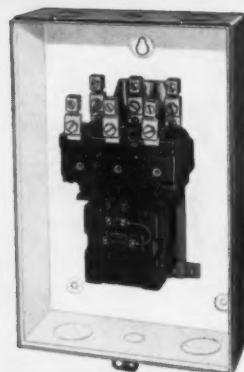
BULLETIN 705 SIZE 2
across-the-line reversing starter
and overload relays in Nema
Type 1 enclosure.



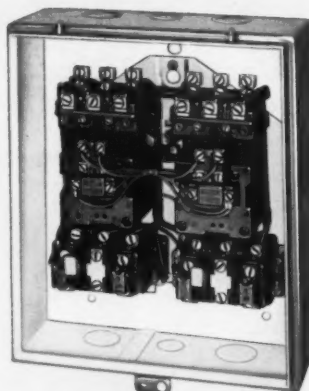
BULLETIN 712 SIZE 2
combination starter in
Nema Type 1 enclosure.



BULLETIN 709 SIZE 3
across-the-line solenoid starter
in Nema Type 1 enclosure.



BULLETIN 702 SIZE 3
three-pole, a-c solenoid contactor
in Nema Type 1 enclosure.



BULLETIN 715 SIZE 1
across-the-line, two-speed
starter—with two overload re-
lays per speed—in Nema Type
1 enclosure.

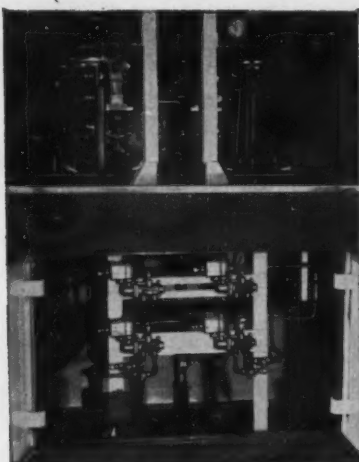


15-61-MR

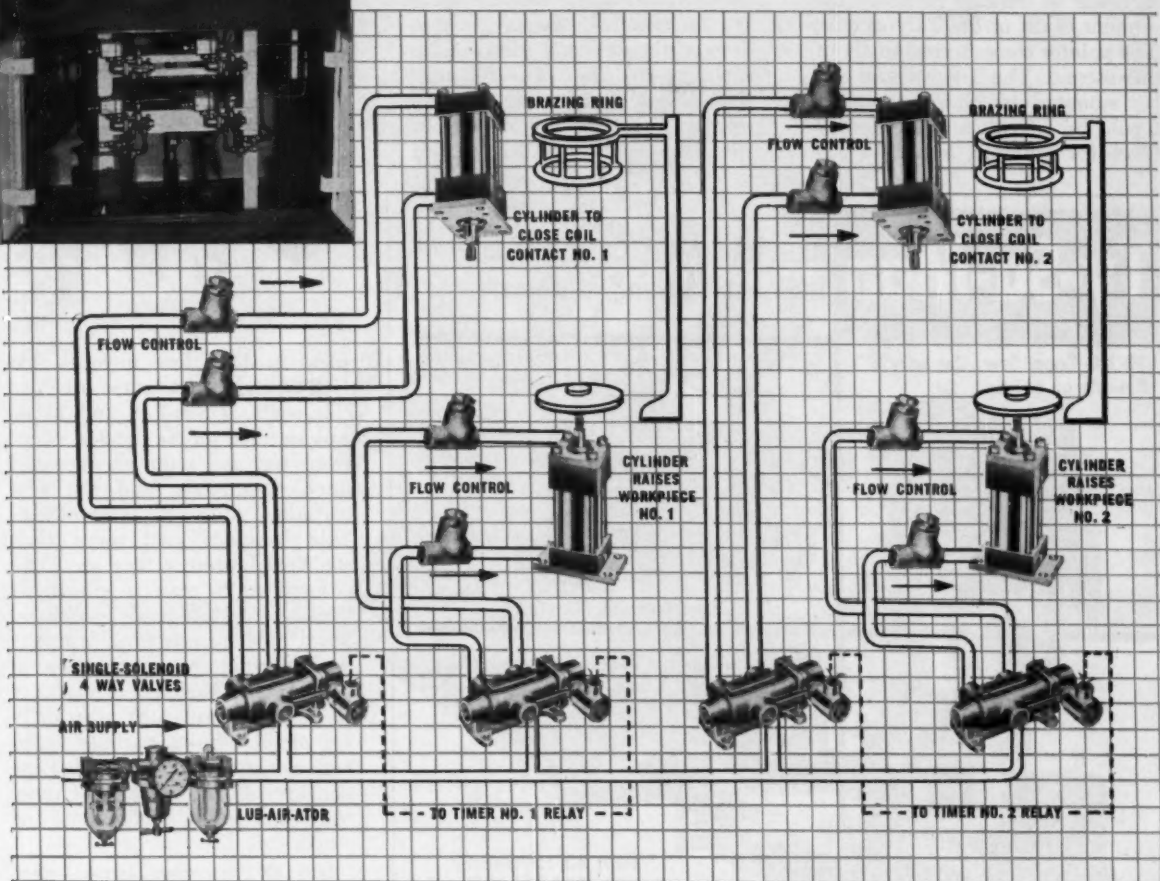
ALLEN-BRADLEY

Member of NEMA

**QUALITY
MOTOR CONTROL**



General Electric Company's Apparatus Service Shop in Detroit, Mich., uses Schrader air circuits to actuate and control this brazing machine. It enables one man to braze 120 planet carrier gear assemblies for automotive transmissions in one hour. Double-acting cylinders, actuated by solenoid valves, lift the assembly into position within the coil for brazing the shaft to the gear, and lower it for water quench. JIC cylinders control the induction heating coil contacts. According to Frank A. Ross, the designer, Schrader's Flow Control Valves close contacts so gently that they perform 750,000 cycles before needing replacement. In addition, air works successfully in a strong magnetic field, and the circuits can be simple.



TOUGH BRAZING JOB BECOMES A BREEZE... WITH SCHRADER AIR CIRCUITRY

PROBLEM: Strong magnetic field . . . complex movement of parts . . . speed requirements . . . precise actuation of coil contacts.

SOLUTION: Simple Schrader air control of mass production operations.

Schrader Air Products are designed to operate together in varied combinations to produce practically unlimited re-

sults. Their quality and versatility make them capable of *simplifying* production . . . while speeding it up . . . at unmatched low cost. Are you failing to utilize fully the air you already have? Follow this Detroit plant's example. Examine your production facilities with air in mind. Make many operations simpler and more efficient by applying any or all of the complete line of Schrader Air Control Products.



This new Schrader catalog is available at your Schrader distributor, who is stocked with the complete range of sizes and types of Schrader air circuitry products. Consult the Yellow Pages or write Schrader.

FULL LINES OF QUALITY AIR CIRCUIT COMPONENTS • OFF-THE-SHELF SERVICE AND INFORMATION FROM YOUR NEARBY DISTRIBUTOR • STAFFED WITH AIR CIRCUIT EXPERTS • CONSULT YELLOW PAGES OR WRITE FOR HIS ADDRESS

Schrader
a division of SCOVILL

A. SCHRADER'S SON

Division of Scovill Manufacturing Co., Inc.
454 Vanderbilt Ave., Brooklyn 38, N. Y.

QUALITY AIR CONTROL PRODUCTS

a pair of variable inductance transducers which provide an electrical displacement signal. This signal is amplified to feed a center-zero meter. The Talyvel is battery-operated. Its transistorized amplifier and meter are scaled both in angular measure as well as linear to indicate precisely the amount of tilt of the Talyvel unit. The pointer comes to rest in about one second. The Talyvel unit can be mounted in places where it would be difficult to read a block level—for example, inside an en-

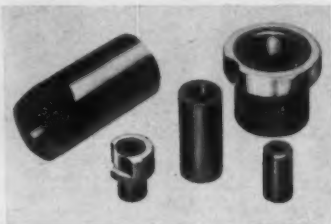
closure or on a high structure. The meter unit can be placed at a distance up to 300 feet from the level unit, where it can be conveniently seen and read. The Talyvel is particularly valuable for such applications as machine tool testing, releveling and adjustment, on launchers for missiles and rockets, for determination of sway of large structures, and for machine tool research. Two Talyvel units can be used for testing surfaces in two directions simultaneously. Also, the instrument lends itself

to permanent installation in machines, buildings, bridges, structures, and foundations to keep check on settling and shifting.

Circle 606 on Readers' Service Card

Ex-Cell-O Carbide Bushings

Carbide bushings now available along with other bushing products manufactured by Ex-Cell-O Corporation, Detroit, Mich. The com-



plete bushing line includes Ex-Cell-O and A.S.A. standards and thin-walls, Trans-Lok and Press-Lok serrated on the outside diameters for use with plastics and ductile materials, and the new carbides. Although tungsten-carbide bushings cost more than standard bushings, they are more economical in many applications because of decreased machinery down time for changing bushings on high-production runs. Also, in cases where bushings are subject to extreme wear, such as in drilling angular holes, carbide bushings can give accurate hole location over a longer period of time, with the added advantage of longer drill life.

Circle 607 on Readers' Service Card

Soft-Faced Hammer

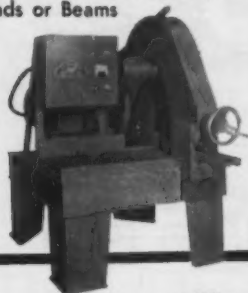
One of a line of soft-faced hammers introduced by Armstrong Bros. Tool Co., Chicago, Ill. The hammers in this new line are designed to hold interchangeable nylon tips of varying degrees of hardness. The tips, which are color-coded to indicate hardness, are resistant to oil, gasoline, and



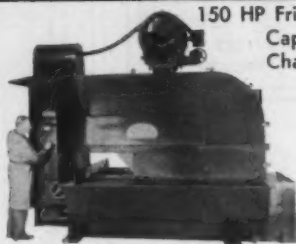
Ty-Sa-Man

America's Most Complete Line of Industrial Sawing Machinery

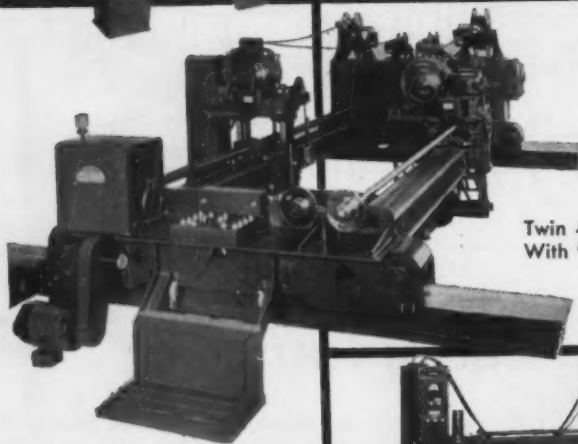
30 HP Chop Saw, Capacity 8" Rounds or Beams



150 HP Friction Saw Capacity 24" Channel

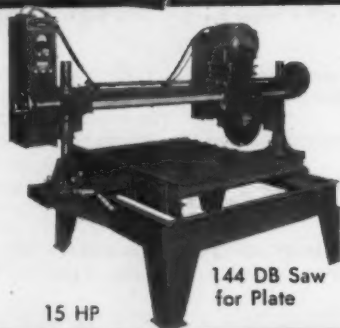


75 & 40 HP Model Available



Twin 40 HP Gantry With 90° Heads

If you can't cut it with a standard saw . . . call us! Ty-Sa-Man has built thousands of special and standard saws, one of which may solve your problem. If not, our engineering staff is at your disposal.



15 HP

144 DB Saw for Plate

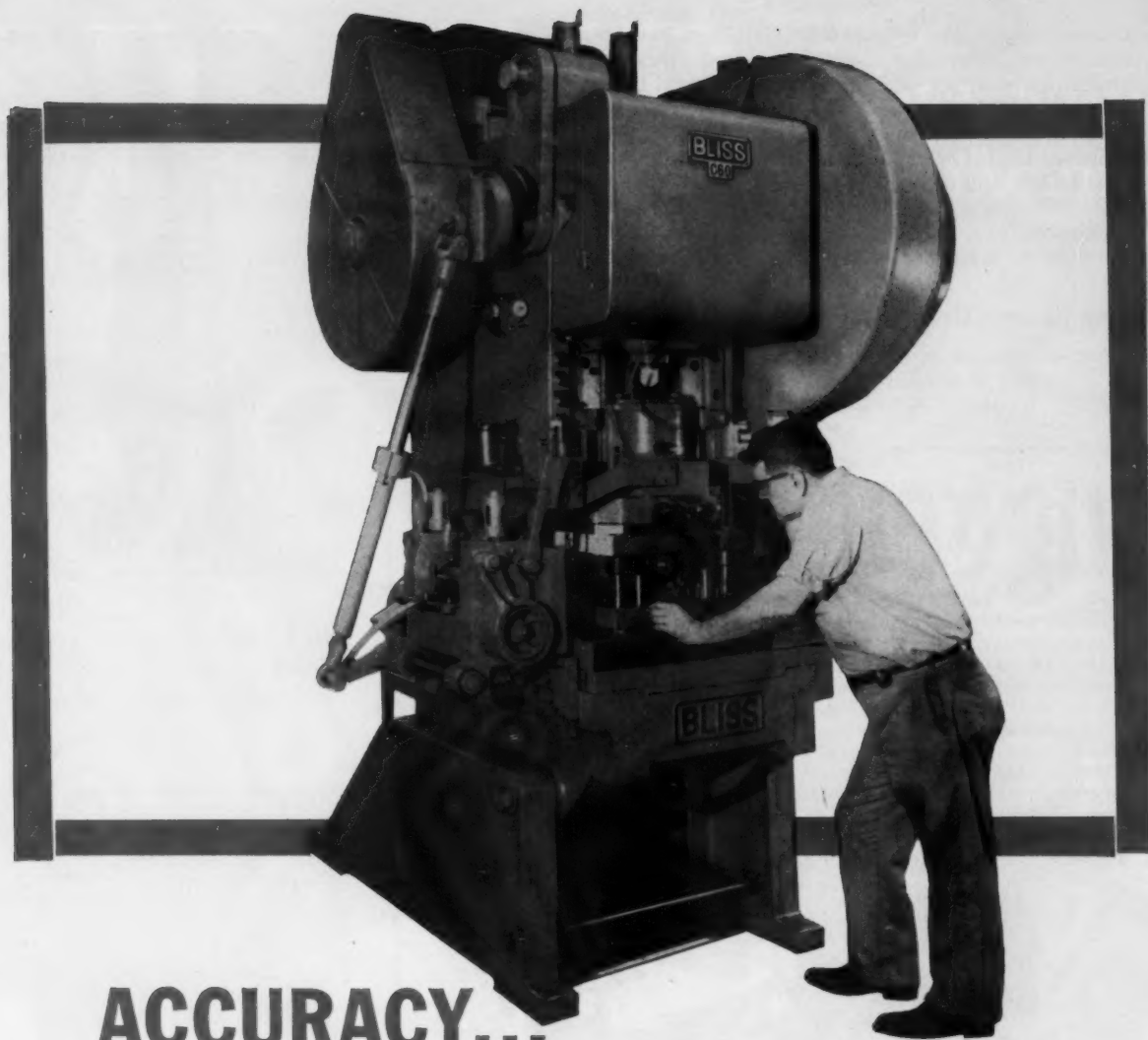
TY-SA-MAN
MACHINE COMPANY, Inc.
1093 White Avenue
Knoxville 1, Tennessee

Write Today for Free Brochure

A brochure pictures and describes the functions of many metal saws. If you have a cutting problem, write or call today.

For more data, circle this page number on Readers' Service Card

MACHINERY, October, 1961



ACCURACY...

that pays off in longer die life, longer press runs before regrinds, with new Bliss Big "C's" and new Bliss "swing-out" portable feeds

The extremely rigid design of Bliss Big "C" inclinables keeps frame deflection to a minimum, even when running at maximum tonnages. What does this mean in terms of actual performance? . . . At Oak Manufacturing Company, Crystal Lake, Ill., eighteen new Big "C" inclinables, equipped with special new Bliss "swing-out" roll feeds, have cut rejection rates sharply. In the case of one very difficult stamping, the rate has improved from 10% rejections down to 1%!

The new Bliss feed is far more accurate than the ones previously used. Moreover, it is designed to swing out away from the press during hand feeding, and can be readily transferred from press to press, regardless of the tonnage (Oak's new Big "C" presses range from 22-ton to 60-ton capacities).

The quality of Bliss Big "C" presses is spelled out both in their strength and, above all, in the precision of their construction, including nearly perfect parallelism between slide and bed, the close tolerances of all working parts, and in the high quality of material in the castings and forgings. Want more facts? Write us now for a complimentary copy of our detailed, full-color catalog.

BLISS is more than a name . . . it's a guarantee

E. W. BLISS COMPANY • Press Division • Hastings, Mich.

PRESSES • ROLLING MILLS • ROLLS • CONTAINER MACHINERY • CONTRACT MFG. • PUBLIC SAFETY

BLISS

SINCE 1857

common industrial acids. The soft faces prevent marring of finished surfaces and will not gash, mushroom, or chip. The hammers are offered in three sizes having head diameters of 1 1/4, 1 3/8, and 1 3/4 inches, and the replaceable tips are available in three grades of hardness.

Circle 608 on Readers' Service Card

Van Keuren Height Gage

Twelve-inch height gage to measure a smaller dimension than 1 inch, to which 12-inch height

gages have heretofore been limited. This "Hyt Size Gage" announced by the Van Keuren Co., Watertown, Mass., will measure from 0.250 to 12 inches and is accurate to 0.000050 (50 millionths) inch on any measurement. The gage can be set in steps of 0.0001 inch to any dimension within its range. The spring-loaded construction of the measuring column eliminates all chance of backlash because the pressure in the measuring column is equal at either end of the 1.000-inch travel of the micrometer screw. Accessories



available include 3- and 6-inch riser blocks and 18- and 24-inch transfer stands.

Circle 609 on Readers' Service Card

rugged!

Logan / 14" LATHES

To withstand the terrific strain of metal-machining, a lathe must be rugged—*real* rugged. Logan lathes are. Solidly built headstock features large oversize spindle and ball bearings. Rugged carriage has double-walled apron, large tool post, and heavy-duty compound rest assembly. Extra-heavy duty tailstock provides rigid support for work. Wide, machine-cut change gears are made of "Ductile Iron." They have as much as triple the strength of some cast iron gears, and tensile strength superior to most steel change gears. The 10" x 56" lathe bed is another example of Logan ruggedness. Oversize ribs and balanced sections of even thickness effectively neutralize internal stresses. Lathe's capacity (14 1/2" swing over bed, 9" swing over saddle, and 28" center distance) combined with ball bearing variable speed drive of 40-1400 rpm (no stopping to shift belts), makes Logan the best dollar value in the lathe field. Complete information on request.



MODEL 6510
\$1,775.00
F.O.B. FACTORY

Logan

LOGAN ENGINEERING CO., DEPT. E-1001
4901 W. Lawrence Ave., Chicago 30, Ill.

"Plant-Central" Control

"Plant-Central" control cabinet, comprising equipment consisting of a wide variety of building-



block units of a factory control system for management, brought out by the Weltronic Co., Southfield, Mich. This new concept in central plant control has been described as the missing link between plant automation and office automation. In most applications, down time is said to be cut by one-half through its application.

Circle 610 on Readers' Service Card
(This section continued on page 226)

EDLUND MODEL NPB

PRINTED CIRCUIT BOARD DRILLING MACHINE

DRILL PRINTED CIRCUIT BOARDS FASTER,
CHEAPER, AND MORE ACCURATELY

Now High Speed, Versatile, Tape Controlled Machine drills Printed Circuit Boards with amazing accuracy in a wide variety of material at low cost.



This High Production drilling machine is actually 16 drills in 1, it drills four boards or stacks of boards simultaneously, operating at 50 cycles per minute under average conditions. **Time Saving Versatility** is featured with 4 independent air feed units in each drilling cluster, each unit capable of carrying a different drill size and operating at spindle speeds up to 22,000 RPM. The **Tape Controlled point positioning** table and drill units assure maximum accuracy and reliability. Now drilling speed and size changes are done automatically, eliminating time consuming manual tooling and set-up.

Printed Circuit Boards
Drilled on Edlund Machine

EDLUND PROGRAMMER PREPARES TAPE DIRECTLY FROM ART WORK

This unique Programmer prepares 1" 8-channel tape **DIRECTLY** from the draftsmen's art work at a **LOW INITIAL** and **LOW UPKEEP** cost.

ELIMINATE MASTER BOARDS and **SAVE** by preparing tape directly from art work. **HIGH SPEED PERFORMANCE** locates up to 30 positions per minute. **MAXIMUM ACCURACY AND RELIABILITY** are the result of the unique design which corrects errors in the art work and keeps the programming process on the desired grid automatically. **INDEPENDENT OPERATION** permits tapes to be prepared when drilling machine is in use. **COMPLETE VERSATILITY** is provided by precision interchangeable slides allowing the Programmer to handle grid sizes down to .025" including unusual grids.

Write for **FREE** Descriptive Bulletins

EDLUND
MACHINERY COMPANY

Division of Harsco Corporation Cortland, New York

Edlund Representatives in Major Cities

Edlund Model TPR Programmer for Tape



Chambersburg Engineers to Receive Medals from Franklin Institute

Three men from the Chambersburg Engineering Co., Chambersburg, Pa., will receive Edward Longstreth Medals from the Franklin Institute for their modern method of forging metal into parts by use of the "Impacter," a horizontal forging hammer based on the counterblow principle.

Robert L. Alcorn, Jr., Cham-

bersburg research engineer, Eugene C. Clarke, former president and now director, and Henry A. Weyer, chief engineer, will be honored at the institute's Medal Day ceremonies on October 18. The Impacter, introduced in 1952, facilitates the automatic production of a wide diversity of drop-forged parts.



Eugene C. Clarke



Henry A. Weyer



Robert L. Alcorn, Jr.

Recipients of Edward Longstreth Medals from the Franklin Institute are engineers from Chambersburg Engineering Co., Chambersburg, Pa.

HAMILTON *Tapping* MACHINE

SUPER SENSITIVE

2992



Capacity — 000-120 to 10-24

In the field of small hole, precision tapping the HAMILTON Super Sensitive Tapping MACHINE stands alone. It is smooth, silent, precise, and sturdy. Spindle returns to neutral position and stops rotation instantly and automatically when pressure on the feed lever is released. To learn what this means to you,

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THE HAMILTON TOOL COMPANY

834 SOUTH NINTH STREET

HAMILTON, OHIO



New!

DESIGN OF WORM AND SPIRAL GEARS

by Earle Buckingham, Professor Emeritus, Massachusetts Institute of Technology; Gear Consultant

and
Henry H. Ryffel, Gear Consultant, Superior Manufacturing & Instrument Corp.; Associate Editor, MACHINERY's HAND-BOOK

Answers Questions Like These

HOW DO YOU ...

- design fine-pitch worms for indexing?
- design worm and spur gear drives?
- design spiral and worm drives with shafts at less than 90 degrees?
- design critical worm gear drives?
- calculate acceleration and dynamic loads?
- determine radiation of heat and oil cooling?
- determine mechanical efficiency of spiral and worm drives?
- replace spiral gears with a worm drive?
- use diametral pitch worms for high speed and small reduction ratios?
- design housings?
- mount worms and worm gears?
- design built-up worm gear blanks?
- use small screw threads as worms?

WHAT IS KNOWN ABOUT ...

- the effect of all-recess action on coefficient of friction?
- the use of torsion bars to reduce dynamic loads?
- lubrication, friction, and wear?
- influence of position of pitch plane on contact between worm and gear?
- the misuse of the hunting tooth?
- relation of pitch surface forms to axes of gears?
- influence of misalignment on the forms of pitch surfaces?

WHAT IS THE NATURE OF ...

- contact conditions of spiral gears?
- contact on enveloping worms?
- conjugate gear tooth action on worm drives?
- load distribution across the face of worm gears?
- limits of conjugate gear tooth action?
- axial thread forms produced by different methods of cutting?
- effect of pressure angle on contact of worm gears?
- effect of lead angle on contact worm gears?
- effect of diameter on contact of worm gears?

WHAT PROCEDURES ARE USED TO ...

- design a complete spiral gear drive?
- design a complete worm gear drive?
- make an analysis of bearing loads for spiral and worm gear drives?
- make a graphical contact analysis?
- make an analytical contact analysis?
- determine the line of zero pressure angle?
- design for specified center distances?
- develop a practical series of speed-reducing worm drives?
- design step-up drives?
- design spiral gears by geometric similarity?
- determine center distances for all-recess action?

ORDER FORM

THE INDUSTRIAL PRESS, 93 Worth Street, New York 13, N.Y.

YES! Rush me copies of "DESIGN OF WORM AND SPIRAL GEARS" @ \$15.00. ☐ Check or money order enclosed. Send book postpaid.

- ☐ I will send payment plus 15¢ if I keep the book.
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When the Carbide-Tipped Shell has been expanded to its full limit . . .
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- ELIMINATE THE EXPENSE of buying complete new reamer.
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NEW PRODUCT BRIEFS

HYDRAULIC POWER PACKAGES available in tank sizes of 10, 20, 40, and 80 gallons announced by Vickers Incorporated, division of Sperry Rand Corporation, Detroit, Mich. Each package includes an electric motor (sizes to 40 hp), piston and vane pump (sizes to 60 gpm), relief valve, and the reservoir.

Circle 611 on Readers' Service Card

ELECTRODE OF EXTRUDED COATED TYPE in AWS Grade AL-43 for all-position welding, with direct-current reverse polarity, of aluminum plate, sheet, and casting made available by Air Reduction Sales Co., New York City. Provides tensile-strength yields up to 28,000 psi. Comes in 1/8- and 5/32-inch diameter sizes.

Circle 612 on Readers' Service Card

PILLOW BLOCKS of heavy-duty type equipped with self-aligning, single-row, deep-groove precision ball bearings which conform to basic standards of the AFBMA (Anti-Friction Bearing Manufacturers Association) brought out by the Link Belt Co., Chicago, Ill. Made in a complete range of shaft sizes from 5/8 to 4 inches.

Circle 613 on Readers' Service Card

SQUARE-HOLE MACHINING APPARATUS that employs new patented method announced by James E. O'Donnell, Lynn, Mass. The process is essentially a boring operation with a single-pointed nonrotating boring tool that can be done on a standard engine, turret, or production type boring machine.

Circle 614 on Readers' Service Card

NUMERICAL TAPE CONTROL package announced by Ultra-Sonic Precision Co., Inc., Mount Vernon, N. Y., makes it possible for the small shops as well as the bigger outfits to automate precision milling. The package contains: tape punch, a transistorized measuring machine that operates electromechanically to punch tape for desired operations; Bridgeport vertical miller, completely fitted with a digital transducer assembly, position indicating controls, and motor drives; and control console, fully transistorized and containing a digital converter, tape reader, and motor controls. Designed

MACHINERY, October, 1961

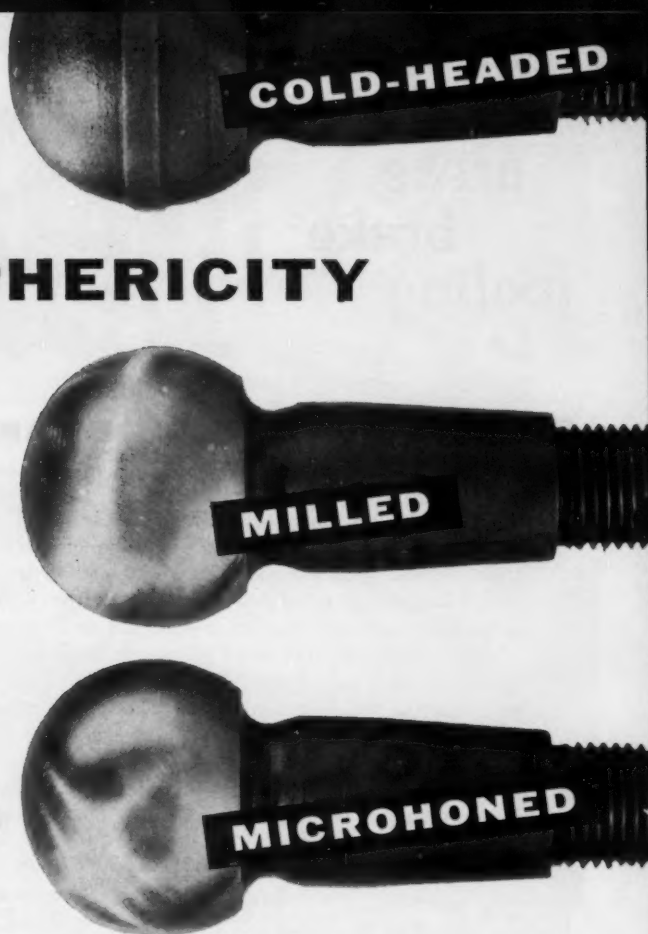
.0003" SPHERICITY

from

cold-headed

to

finished surface



... in just two operations

True sphericity, with closer control of size and surface finish than previously possible, is accomplished in only two cost-cutting operations by the new Micromatic process for machining truncated spheres.

The only machining operations on the spherical end are milling and Microhoning. Combining new techniques with specially developed spherical milling and Microhoning machines, the process generates sphericity within .0003" tolerance and a controlled microinch finish of 6-10 rms. (Former methods were hard pressed to productively obtain sphericity within .002".)

All the machining and polishing operations—such as turning, grinding, buffing—which old processing methods required on the spherical end are eliminated. Also, some operations on other parts of the workpiece (e.g., turning and grinding of the taper shank) are no longer necessary.

The new method can be applied to any truncated sphere which has a shank or bore to permit holding without touching the sphere. Micromatic will be happy to show you the dramatic savings being enjoyed by leading production plants using its spherical process.



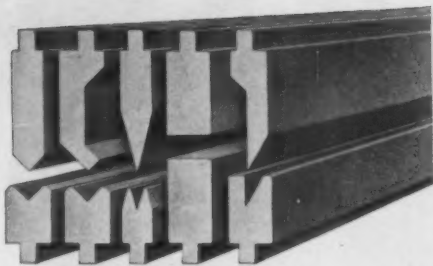
Shown at left is a clutch release lever before and after spherical milling. In this case, accuracies and surface finish milled are perfectly satisfactory for assembly without further processing of the sphere.



**MICROMATIC HONE
CORPORATION**

8100 SCHOOLCRAFT • DETROIT 38, MICHIGAN

press brake tooling



Standard Type PRESS BRAKE DIES

62 different sizes and styles • Most in stock for off-the-shelf delivery

CHICAGO standard type press brake dies are used for a large variety of bending operations in any make or size of standard press brake. They are economical, and the quick delivery saves time in tooling up. Available in any length from 4 to 12 feet in increments of 2 feet; induction hardened or Diechrome steel.

The local distributors listed below offer immediate delivery on many sizes and styles of standard type CHICAGO press brake dies. If you have Bulletin STD-959 you can order any standard type die by number. Why not ask your nearest distributor for a copy? Also, if your requirements call for special multibend and forming dies, he can tell you about Dreis & Krump complete tooling service for any make of press brake.

Call your nearest distributor

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to give plus or minus 0.001-inch accuracy on both longitudinal and cross-slides; miller supplied with high-precision ball-nut lead-screw in both longitudinal and cross-slides and hard chromium ways; and measurement in both directions, from a zero reference point.

Circle 615 on Readers' Service Card

FLAME-CUTTING MACHINE

weighing only 19 pounds, known as the CM-75 Cadet, has been introduced by the Linde Company, division of Union Carbide Corporation, New York City. Fast, clean cuts in metals ranging in thickness from light gage to 2-inch thick sheets can be made with this machine. Equipped with a clutch that allows instantaneous free-wheeling control, making it suitable for hand-guided contour-cutting. Designed to perform exceptionally large variety of cutting work.

Circle 616 on Readers' Service Card

DOWEL-PINS OF STAINLESS

STEEL are now available from the Star Stainless Screw Co., Paterson, N. J. These pins are used in the instrument, radar, computer, meter, and missile industries. They range in size from 1/32 to 1/2 inch in diameter in increments of thirty-seconds and sixty-fourths, with a tolerance of plus or minus 0.0002 inch. Available in minimum or large quantities. Specials can be made to order.

Circle 617 on Readers' Service Card

BALL SCREW of exceptional size and length manufactured by Beaver Precision Products, Inc., Clawson, Mich., to move the table on huge steel mill roll lathe. The lathe, built by the E. W. Bliss Co., Canton, Ohio, was designed by its Mackintosh-Hemphill Division in Pittsburgh, Pa. The ball screw is almost 40 feet long and is made of 3 1/2-inch outside diameter hardened tubing.

Circle 618 on Readers' Service Card

PELLON PAD heavy-duty high-density polishing chemotextile for use in production lapping and polishing announced by Geoscience Instruments Corporation, New York City. The pad is a semipermanent tool surface that is said to maintain flatness to 1/2 millionth of an inch and outwear hard metal laps by a factor of 4. Especially adapted for use in metal-finishing and honing metallography, gage-blocks, mechanical seals, optical flats, ceramics, and precision components.

Circle 619 on Readers' Service Card

A Tradition of Quality and Value since 1899

Press Brakes • Press Brake Dies
Hand and Power Bending Brakes
Special Metal-Forming Machines



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MORE TOOLPOWER than Sets Twice its size

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NEW COMBO SET

IDEAL FOR MAINTENANCE AND GENERAL REPAIRS

Set No. SP-1
1/2" SQUARE DRIVE

Total List Value
of individual pieces
\$33.91
SPECIAL
LIST PRICE

\$30.00

FEATURING COLD IMPACT EXTRUDED SOCKETS



Cross section of conventional socket machined from bar stock and hot punched. Note undercut necessary for metal displacement by hot punching of double hex opening.

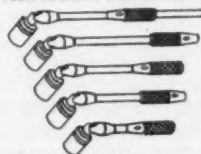


New impact extruded socket with closer tolerances has greater strength and longer life. Note the clean lines and lack of any undercut for metal displacement that comes with controlled metal displacement.



ONLY SEVEN DRIVER PARTS AND ELEVEN SOCKETS MAKE HUNDREDS OF QUICK-CHANGE DRIVER COMBINATIONS

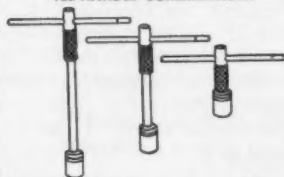
FLEX HANDLE COMBINATIONS



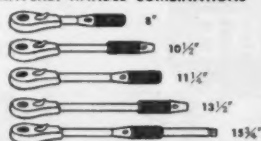
RATCHET HEAD AND FLEX JOINT COMBINATIONS



TEE-HANDLE COMBINATIONS



RATCHET HANDLE COMBINATIONS



PRICE • QUALITY PERFORMANCE

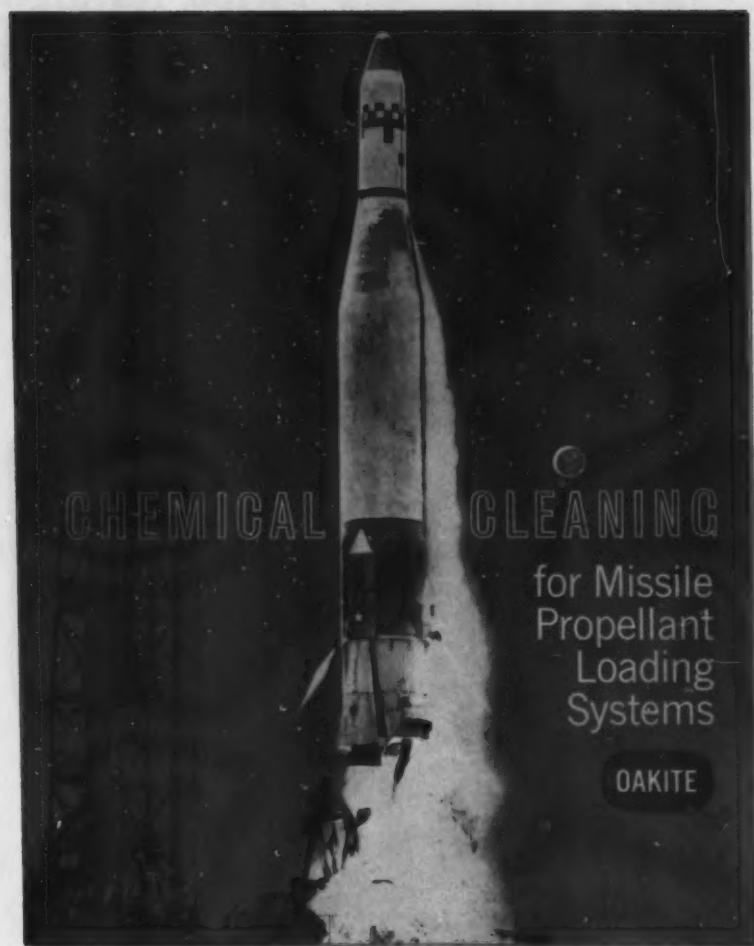
... all describe the greatest Socket Set Value ever offered. Lightweight and compact, it is as handy for field use as on the shop bench. All parts are made of selected alloy steel, heat-treated and finished with heavy chrome-plating over nickel. Drive parts 1/2 inch square ... sockets from 3/8" to 1". Ask your Distributor for Williams Combo Set No. SP-1.

J. H. WILLIAMS & CO.

DIVISION OF UNITED-GREENFIELD CORPORATION

409 VULCAN STREET

BUFFALO 7, N. Y.



Send for this **NEW BULLETIN** on successful cleaning of **MISSILE PROPELLANT SYSTEMS**

This helpful new bulletin discusses cleaning and passivating missile propellant loading systems (1), in the plant during fabrication and before shipment, and (2), at the launching site.

Bulletin explains why removal of all soil larger than .0004 inch is a job for a cleaning expert . . . tells how to obtain the services of that expert at no cost to you. Ask your local Oakite man for a copy, or write Oakite Products, Inc., 26 Rector Street, New York 6; N. Y.



CENTERLESS GRINDER BLADES, designated O-KNI-CO, made by the Ohio Knife Co., Cincinnati, Ohio. Designed to provide efficient, precision grinding on straight production runs as well as in job shops where short runs and frequent changes are the rule. For through-feed and infeed grinding on all types of centerless and double-disc grinding, in sizes and types for all work diameters ranging from 0.060 to 6 inches. Furnished with tips or inserts of tungsten carbide or high-speed steel.

Circle 620 on Readers' Service Card

VALVE AND CAM ACTUATING UNIT designed to facilitate installation of mist cooling system on all types of punch presses is being made by Aetna Mfg. Co., Bensenville, Ill. "Mistic Mist" generators, for which these valves are designed, operate with shop air lines and pressures.

Circle 621 on Readers' Service Card

AIR-OPERATED SCREWDRIVER, designated the Thor "Straight-8," featuring a silencer and twin-clutch torque control for driving small screws and nuts up to Size 8 threaded fasteners announced by Thor Power Tool Co., Aurora, Ill. Available in four speeds from 500 to 4500 rpm and variety of driver heads.

Circle 622 on Readers' Service Card

EXHAUST PURIFIER designed to end hazards caused by fumes from internal combustion engines announced by Oxy-Catalyst, Inc., Berwin, Pa. For use where the dangerous gases are exhausted into enclosed or confined areas. Recommended for employment even when there is no immediate threat of carbon-monoxide poisoning because the active fumes from gas, gasoline, or diesel equipment can cause headaches, eye irritation, and nausea, and may even have long-term ill effects on the health of the employees working in the area of such vehicles.

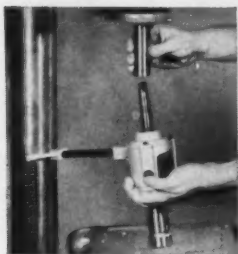
Circle 623 on Readers' Service Card

SOLID-CORE KENFACE ARC ROD KT-20 for electric arc application of tungsten-carbide hard facing developed by Kennametal Inc., Latrobe, Pa. This rod is particularly recommended for large pieces on which other hard-facing methods are impractical. It is composed of a solid tungsten-carbide core surrounded by a steel sheath with a coating that permits depositing a hard surface as smooth as that applied by a mild-steel welding rod. Suitable for either bead or wash pass application.

Circle 624 on Readers' Service Card

IT'S A FACT!

You can tap 1/2" holes
with a light drill press and Supreme's
New **VersaTAPPER**



Shaft of Model 6100 is held in drill press chuck. No. 6200 (above) has Tapered spindle.



Supreme Accutap Chuck is standard equipment with VersaTAPPER. Capacity 0-1/2"



VersaTAPPER is a compact precision-made tapping unit. Fits any drill press... features half-inch capacity range plus 4-time increase in torque. Easy to install. Simple and quick to remove after use.

VersaTAPPER...
operates easily in any material
...with widest capacity range
...yet costs far less

The new VersaTAPPER has scored an instant success with production people everywhere. It has more versatility than other tapping devices. It has the *widest capacity range*—from 0 to 1/2", but depending on application, use of taps smaller than No. 10 is limited. It develops *more power*—makes the tapping of 1/2"-13 holes a simpler matter, even with

light duty drill presses. VersaTAPPER is *simple to use*—can be successfully operated by anyone in your shop.

All of these features at the remarkably low price of \$63.00 complete marks VersaTAPPER as a product you must see at the first opportunity. It's available at your local Supreme Chuck distributor. Call him soon.

\$63
JUST
COMPLETE

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You get more from
power tools with
Top Quality
Supreme Accessories



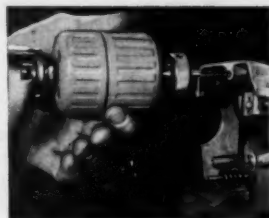
Supreme Brand Chucks

Noted for unmatched quality. The widest range of sizes and types...one for every machine in your shop. Exclusive Supreme hardening means greater accuracy—longer wear.



Supreme Versamatic

Reversible speed reducer for portable drills. Fits all makes—permits their use for power screw driving, nut running and heavy duty drilling. 7 to 1 reduction means high torque increase. A *fine tool*.



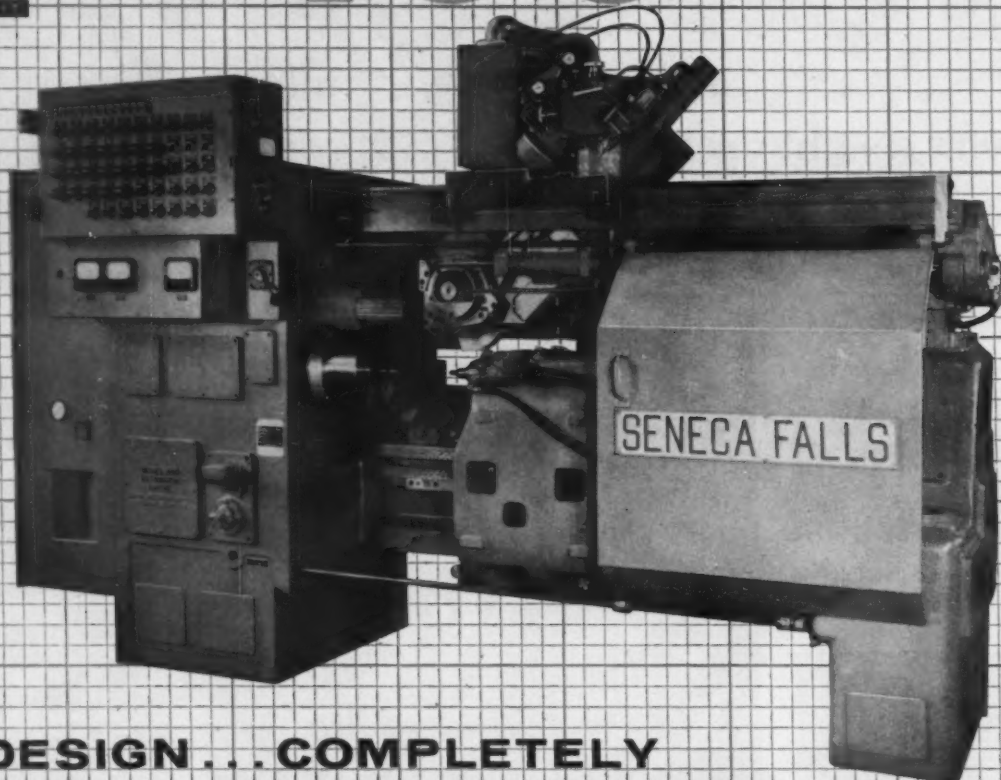
Supreme Push-Pull Tapper

Like the Versamatic, but made for the single purpose of tapping with portable drills. Reverses instantly for tap removal. Handles taps up to 5/16" diameter. Top quality. Simple to operate.

SUPREME PRODUCTS
ARE IN STOCK IN
YOUR CITY.
CALL YOUR
DISTRIBUTOR



model 400 tracer lathe



NEW DESIGN... COMPLETELY AUTOMATIC... NUMERICALLY CONTROLLED

EXCLUSIVE FEATURES

- Numerical control system for most efficient set-up procedure.
- Electromechanical screw feed mechanism provides dual infinitely variable rates in inches per revolution of spindle.
- Five constant HP headstock options, including a special design rated at 90 HP for DC drive.
- Straight line size adjustment with direct reading dial indicators.
- Carriages and squaring attachments can pass behind tailstock.
- Electromechanical tracer system.
- Unique tilted dovetail for tracer slide efficiency.

The Seneca Falls Model "400" Automatic Tracer Lathe is engineered to provide maximum productivity at minimum cost on all types of turning operations. Its modular design, emphasizing structural massiveness in every component, insures the rugged stability needed for high horsepower metal turning.

Model "400" embodies a completely new feed system... no clutches, no gearing, no hydraulics. While providing infinitely variable feeds, this system automatically maintains a constant relationship between feed rate and spindle RPM.

Five headstock options offer spindle speeds up to 3700 RPM. Numerous carriage options will handle virtually any turning or boring operation. Roughing operations can be accomplished with multiple tools on a rear carriage while finishing with the overhead tracer carriage... combining the advantages of both methods in a single chucking.

Model "400" is furnished with a point-to-point numerical control system having, as standard, a calibrated dial input facility. Punched tape input is optional. Other unique features of this amazing new lathe are described in Bulletin 4061. Get your copy.

write for
Bulletin 4061



SENECA FALLS MACHINE CO., SENECA FALLS, N. Y.

California

DR. LESTER C. VAN ATTA has been named technical director of HUGHES AIRCRAFT Co.'s research laboratories at Malibu, Calif. Dr. Van Atta recently completed a year's service in Washington, D. C., as special assistant for arms control for the director of defense research and engineering in the office of the Secretary of Defense. He joined Hughes in 1950 as head of the microwave laboratory.

GEORGE F. HEATH has been appointed district sales manager by AMERICAN SEALANTS Co., Hartford, Conn. Based in Los Angeles, Calif., he will work with the company's representatives and distributors to coordinate sales of the company's Loctite brand sealing and locking compound throughout the eleven-state western area.

Illinois, Indiana, and Ohio

MINNEAPOLIS-HONEYWELL REGULATOR Co., Micro Switch Division, Freeport, Ill., has announced a number of changes in its sales organization. C. T. MORISON, former branch sales manager in Washington, D. C., has been named branch sales manager for the New York office. He replaces WILLIAM BETZ, who has been appointed aircraft products sales manager for Honeywell's Precision Meter Division in Manchester, N. H. Replacing Mr. Morison in Washington is FLOYD M. CASSIDY, former market manager for aircraft, missiles, ordnance, and marine applications. Mr. Cassidy's duties have been assumed by DONALD SCHULTZ, who has been transferred from Micro Switch's Charlotte office to Freeport.

JOHN G. NORRIS has been made assistant to the president of FAN-STEEL METALLURGICAL CORPORATION, North Chicago, Ill. Prior to this appointment, Mr. Norris was associated with the office of GRAHAM PARKER, where he was a senior executive in the Paris office of the European Division.



John Powers, vice-president/operations, Verson Allsteel Press Co.



Henry De Matteo, manufacturing and works manager for Verson Allsteel Press Co.

VERSON ALLSTEEL PRESS Co., Chicago, Ill., has announced two new appointments. JOHN POWERS has been named vice-president/operations, and HENRY DE MATTEO has been made manufacturing and works manager. Mr. Powers was formerly manufacturing manager; Mr. De Matteo, works manager.

SIBLEY MACHINE & FOUNDRY CORPORATION, South Bend, Ind., has an-

nounced the following changes in management. JOHN E. MCINTYRE, formerly vice-president and general manager, has been elected president. WILLIAM H. VOLL has been named vice-president in charge of sales, and PHILIP G. HAHN, former controller, has been elected to the position of



John E. McIntyre, newly elected president of Sibley Machine & Foundry Corporation

secretary of the corporation. BERNARD J. VOLL, after serving the company for thirty-nine years as president, has been made chairman of the board.

A. J. MARTIN has been appointed assistant secretary of the NATIONAL TOOL, DIE & PRECISION MACHINING ASSOCIATION, Cleveland, Ohio. Mr. Martin has been serving as president of the GREATER ROCKFORD TOOL & DIE MANUFACTURERS ASSOCIATION, Rockford, Ill., during the past year.

Kansas and Missouri

VLIER ENGINEERING CORPORATION, a subsidiary of BARRY WRIGHT CORPORATION, Los Angeles, Calif., has announced the appointment of ELLFELDT MACHINERY &

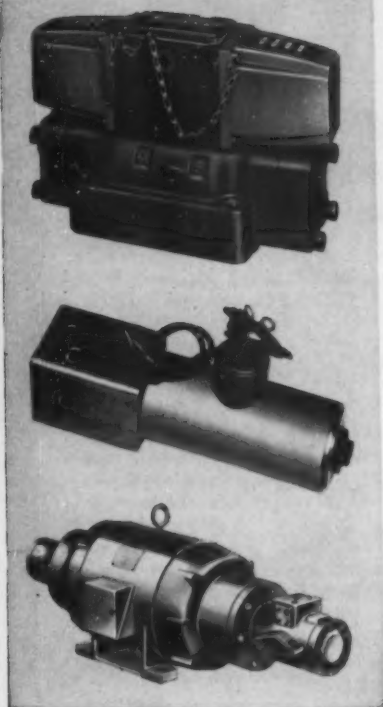
BURGMASTER USES THESE VICKERS COMPONENTS



▲ **POWER PACKAGES**—A complete Vickers 30-gallon hydraulic power supply was custom-designed and built for this machine. Vickers offers standard and custom power packages to meet every type of application need. Get details from your Vickers application engineer.

◀ **DIRECTIONAL VALVES**—Two types of directional valves—solenoid operated and solenoid controlled, pilot operated—are used on this Burgmaster machine. The complete Vickers line of two- and four-way directional control valves is described in Catalog 5001C.

◀ **MINIATURE DIRECTIONAL CONTROLS**—Series D1L two and four-way valves are designed for low volume systems, are suitable for operation to 1000 psi and have 2 gpm capacity. Low current a-c and d-c solenoids are available in all standard voltages. Write for data sheet D1L-1.



▲ **MOTOR PUMPS**—A 5 HP, double-end motor pump is used on this Burgmaster. The complete Vickers motor pump line offers single, double, two-pressure and two-stage pumps. Use of these motor pumps conserves space and eliminates alignment problems between pump and motor. Details are available in Catalog 5001C.

VICKERS®

VICKERS INCORPORATED

DIVISION OF SPERRY RAND CORPORATION

Machinery Hydraulics Division

ADMINISTRATIVE and ENGINEERING CENTER
Department 1403 • Detroit 32, Michigan

SUPPLY Co., Wichita, Kan., as exclusive distributor in Kansas for Vlier tooling accessories, Wespo jig & fixture components, and Wespo toddle clamps.

JOSEPH T. RYERSON & SON, INC., Chicago, Ill., has announced the appointment of WILLIAM J. KALT as general superintendent of the St. Louis, Mo., plant. Mr. Kalt is a veteran of twenty-eight years with the company. For the past eight years he has held the position of general foreman. He is succeeded in this post by JAMES A. BROWN. WILLIAM F. NABER, who was formerly general superintendent of the St. Louis plant, has retired.

Michigan and Wisconsin

BENDIX CORPORATION, Detroit, Mich., has announced that two former military officers, JACK D. KOSER and J. A. OGLE, have joined the staff of DR. G. G. QUARLES, Bendix director of long-range military planning, with headquarters in the company's executive offices in Detroit. Mr. Koser, who has retired as a colonel of the Air Force, will be responsible primarily for long-range planning in areas of interest to the Air Force. Mr. Ogle, formerly an Army lieutenant colonel, will concentrate his activities in those areas of interest to the Army.

PRECISION CASTINGS CORPORATION, an affiliate of DETROIT INDUSTRIAL PRODUCTS CORPORATION, has moved into larger quarters at 21620 Coolidge, Oak Park (Detroit 37), Mich. New induction furnaces have been installed in the 10,000-square-foot plant, along with other special equipment used in the production of "Shaw Process" precision castings. MARK J. SREDEN has been made general manager and GEORGE P. MILLER has been appointed to handle sales for the corporation.

JACQUES CARPENTER has been appointed central regional sales manager in the Industrial Department of VICKERS INCORPORATED, Detroit, Mich. Mr. Carpenter will be responsible for sales to industrial accounts in the Detroit, Cleveland, Ohio, and Pittsburgh, Pa., areas. He has been with Vickers since 1941.

NEIL B. RIEKSE has been made sales engineer for the Michigan, Indiana, and Ohio district of AMERICAN DRILL BUSHING CO., Los Angeles, Calif. Prior to this appointment, Mr. Riekse represented the firm in the Orange County southern California area.

MACHINERY, October, 1961



ANTTI RAIHA, CHIEF ENGINEER, BURGMASTER CORP. SAYS:

"Hydraulic and tape controlled turret drills need sensitive, reliable power systems..."

"... in order to control tool penetration and table positioning where location tolerances must be held to .001-inch. We've worked with Vickers hydraulic power systems since 1951, beginning with our automatic hydraulic models, we are increasing our activity in this area as the demand for turret drilling machines and tape controlled machines grows.

"In addition to the machine shown, we use Vickers hydraulics on seven different standard models as well as on many specially designed variations of these standard machines. We rely on Vickers hydraulic power systems, not only for their unusually high quality, but because they are easy to maintain and we have the additional assurance of the availability of their worldwide service organization.

"Because Vickers application engineers have given us close cooperation and have a thorough understanding

of our requirements, we've been able to develop systems that provide long, trouble-free life."

Whether you are building standard or special purpose machinery, your power and control requirements can be met precisely and economically by the proper application of hydraulic systems. Typical Vickers components and systems used by Burgmaster are shown on the facing page. They are part of the broadest line of top quality hydraulics available anywhere.

VICKERS

VICKERS INCORPORATED

DIVISION OF SPERRY RAND CORPORATION

Machinery Hydraulics Division

ADMINISTRATIVE and ENGINEERING CENTER

Department 1403 • Detroit 32, Michigan

LaSALLE MACHINE TOOL, INC., has moved from its Detroit plant to suburban Warren, Mich., where it now occupies 65,000 square feet of floor space, the better to serve its increasing number of customers everywhere.

CONE-DRIVE GEARS DIVISION, MICHIGAN TOOL CO., Detroit, Mich., has announced the following appointments: F. W. SORESENSEN, formerly plant superintendent, has been appointed manufacturing manager

of the division's plant in Traverse City. J. C. PENROSE has been named manager of Cone-Drive research, in addition to his responsibilities as chief engineer of the division. KENNETH COURTAD, formerly assistant to Mr. Sorensen, has been named superintendent of the Traverse City plant. Mr. Sorensen, who studied engineering at General Motors Institute, joined the Cone-Drive organization in 1942, was named supervisor of processing in 1949, and became plant superintendent in 1956.



F. W. Sorensen, manufacturing manager of Cone-Drive Gears Traverse City plant, Michigan Tool Co.

ROBERT W. BERRY, JR., has been made chief engineer of WESSON CORPORATION, Ferndale, Mich. Mr. Berry



Robert W. Berry, Jr., chief engineer, Wesson Corporation

joined WESSON Co.—one of the group of companies recently merged to form Wesson Corporation—in 1942. He will head the firm's design and product engineering staff.

ALLIS-CHALMERS MFG. CO., Milwaukee, Wis., has elected T. D. LYONS vice-president, administration, Industries Group. Succeeding Mr. Lyons as comptroller is W. S. PIERSON. E. A. SPIKA has been appointed assistant comptroller of the company. In addition, WILL MITCHELL, JR., has been made director, Research Division.

New England

NEW BRITAIN MACHINE CO., New Britain, Conn., has announced that



Model B (Wet or Dry) Dependable. Economical. Easily handles 5" rounds, 10" flats.

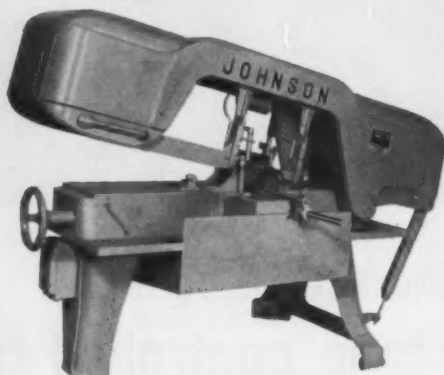


Model M (Mobile). Rolls to the job, inside or out. Capacity: 5" x 10"



Johnson Adjustable Stock Stand. Provides rigid, safe work support.

Johnson Speaks for itself in ANY SHOP!



The Big Model J. (Wet or Dry) Fast. Tough. Accurate. Capacity: 10" rounds, 18" flats

The big, dependable Johnson delivers more saw for less money. It easily and accurately handles anything in your stock pile: rods, angles, tubes, heavy rounds, irregular shapes, and flats.

Whatever model fits your production requirements, you'll find Johnson versatility will boost your production and lower your metal cutting costs. Today, the Johnson saw speaks for itself in thousands of progressive shops... why not yours?



JOHNSON MANUFACTURING CORPORATION
1016 BARNES STREET, ALBION, MICHIGAN

Eastern Distributor
R. J. K. KELLY CO.
Hale Bldg., 51 Main St.
East Orange, N. J.

Mid-Western Distributor
W. Q. LUNDMARK
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Des Plaines, Ill.

Western Distributor
HASTINGS DISTRIBUTORS
1605 Solano Avenue
Berkeley, Calif.

**savings
go
up**

Savings Increased 25%
with Carpenter Stainless No. 8 (Type 303)

**rejects
go
down**

Rejects cut 25%
with Carpenter Stainless No. 5 (Type 416)

Two good "points" are working for you . . .

when you choose Carpenter Free-Machining Stainless

Find a way to increase production, and, at the same time, improve your percentage of "good ones"—and you've found the key to more profits. Carpenter Free-Machining Stainless points the way to both of these goals. The unexcelled machining qualities in Carpenter Stainless No. 5 (Type 416) and No. 8 (Type 303) enable you to run your machines at higher speeds, and run them longer . . . with less downtime for tool refinishing. Their consistent uniformity provides better finishes, closer tolerances, drastically reduces chatter marks and burrs . . . holding rejects to a minimum. These steels, developed in the same laboratories and mills that developed and produced the world's first free-machining stainless steels, are always available for immediate delivery from your nearby Carpenter Service-Center. Call Carpenter today . . . let us point the way to improved profit for you.

Carpenter steel

you can machine it **consistently** better with Carpenter Free-Machining Stainless



The Carpenter Steel Company, Main Office and Mills, Reading, Pa.
Alloy Tube Division, Union, N. J.
Webb Wire Division, New Brunswick, N. J.
Carpenter Steel of New England, Inc., Bridgeport, Conn.



More Can Be Done



With Reed Thread Rolls!

Take full advantage of the possibilities illustrated above which thread and form rolling offer to reduce costs and improve quality. Thread rolling also can eliminate many secondary operations.

Reed, pioneer-leader in the development of all types of thread rolling equipment, supplies thread and form

rolls for a wide variety of applications.

Reed Thread Rolls manufactured under rigid standards of quality control are uniform . . . durable . . . accurate, and available for all types and makes of holders. Over 150 standard sizes regularly stocked . . . plus non-standard rolls on special order.

REED

ROLLED THREAD DIE CO.



Subsidiary of Union Twist Drill Company,

HOLDEN, MASSACHUSETTS

Specialists in Thread and Form Rolling Tools and Equipment

a new sales organization for the New Britain +GF+ copy lathe is being headed by JOHN E. GERMAIN, recently named assistant sales manager of the company. The appointment of two new representatives of NEW BRITAIN-GRIDLEY MACHINE DIVISION to handle exclusively the +GF+ lathe line has also been announced. Appointments include HARRINGTON-WILSON-DAUM CORPORATION, Mount Vernon, N. Y., for the New York area and FOUR STATES MACHINERY Co., Chicago, Ill., for the Chicago area.

The acquisition of WAFÉ MFG. Co., Inc., Bridgeport, Conn., has been announced by MINIATURE PRECISION BEARINGS, INC., Keene, N. H. This is the third acquisition of a precision metalworking company in MPB's expansion program. It follows the acquisition of SPLIT BALL-BEARING CORPORATION, Lebanon, N. H., and CARTER ENGINEERING Co., Ferrysburg, Mich.

The appointment of CLARENCE P. FOREMAN as chief engineer has been announced by BAIRD MACHINE Co., Stratford, Conn. Mr. Foreman joined Baird in 1948, and the following year was named chief tool engineer. In his new position, he will be in direct charge of the company's Engineering Department.

NORTON Co., Worcester, Mass., has appointed SAMUEL M. HINES a grinding-wheel sales representative in the Philadelphia, Pa., area. He was formerly a field specialist at the Philadelphia district office. Also, WILLIAM T. HILDICK has been assigned to the Chicago, Ill., district office as a grinding-wheel field specialist.

The appointment of WILLIAM A. RUSSELL as vice-president, marketing, has been announced by MINIATURE PRECISION BEARINGS, INC., Keene, N. H. Mr. Russell was formerly with NORTON Co., Worcester, Mass.

New York and New Jersey

ELBERT C. BELLOWES has been appointed assistant to the presidents of DE LAVAL SEPARATOR Co., Poughkeepsie, N. Y., and DE LAVAL STEAM TURBINE Co., Trenton, N. J. Mr. Bellowes will have responsibilities in the financial and legal fields and will also handle special assignments from his headquarters in the De Laval New York offices.

METAL & THERMIT CORPORATION, New York City, has announced the

following: H. E. MARTIN has become chairman and chief executive officer. Replacing him as president is CHARLES J. BEASLEY, formerly vice-president and secretary. H. W. BUCHANAN has been named executive vice-president.



Russell B. Miller, new general sales manager of the Chicago Pneumatic Tool Co.

RUSSELL B. MILLER has been made general sales manager of CHICAGO PNEUMATIC TOOL CO., New York City. In his new capacity, Mr. Miller will be responsible for coordinating the sales efforts behind the firm's diversified products, including air and electric tools, compressors, diesel and gas engines, and rock-drilling equipment.

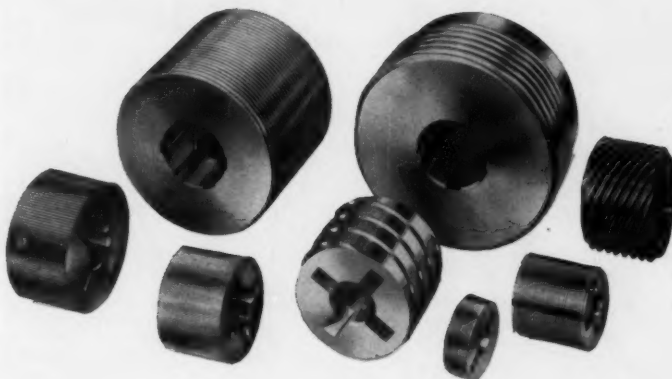
AIR REDUCTION SALES CO., New York City, has announced the following appointments: G. L. WERLY, Jr., has been made general marketing manager. In his new post, Mr. Werly will direct the operations of Airco's Equipment Marketing, Gas



G. L. Werly, Jr., newly appointed general marketing manager for Air Reduction Sales Co.



More Can Be Done



With Reed Cylindrical Dies!

Reed thread and form rolling dies meet the widest range of applications — give you significant advantages with improved performance and reduced operating costs. Manufactured under the strictest standards of quality control, they're uniform . . . durable . . . accurate and available for two

die or three die machines of all makes. Over 130 sizes regularly stocked . . . plus non-standard cylindrical dies on special order.

Let Reed, pioneer-leader in the development of all types of thread rolling equipment, help you get maximum production on all thread or form rolling jobs.

REED

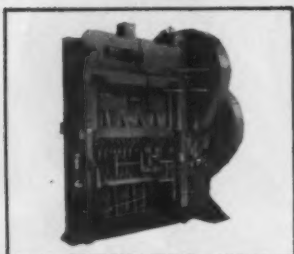
ROLLED THREAD DIE CO.



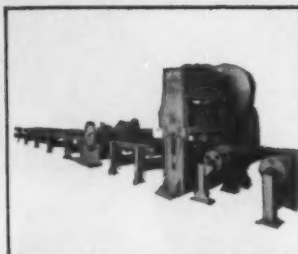
Subsidiary of Union Twist Drill Company
HOLDEN, MASSACHUSETTS
Specialists in Thread and Form Rolling Tools and Equipment



The Many Many Muscles of BEATTY Metalworking Machinery



BEATTY GUILLOTINE BEAM PUNCH
Ideal for punching flanges, and webs of beams. Large die space, clear working space and two-point application of force affords full capacity loading and punching. 200-ton model handles beams up to 30".



BEATTY SPACING TABLE
Precise, automatic spacing of holes and slots in beams, channels, plates. In a single pass-through, one operator and one helper can complete the punching of a flange or web-section in a matter of seconds. Numerical control of carriage available.

Power, strength, speed, agility, efficiency...these are the qualities in demand when heavy metalworking is involved. And these are the properties which Beatty's machinery and equipment brings to the industry. Bending, punching, straightening, shearing, notching, pressing, and flanging... all are child's play for the machines of the versatile Beatty line. There is a Beatty machine to fit each of your metalworking needs; send today for free literature on Beatty punches, presses, shears, bulldozers, and other metalworking equipment.

BEATTY

MACHINE & MANUFACTURING COMPANY

941 150th St.,

HAMMOND, Indiana

Marketing, and Distributor Marketing Departments located in the New York office. R. H. MERRIMAN succeeds Mr. Werly as manager of the Gas Marketing Department, directing the nationwide sale and distribution of Airco industrial gases. L. J. MACLENNAN, JR., has been made assistant manager of distributor sales for the midwestern region. Mr. MacLennan will be responsible for planning, coordinating, and directing distributor sales activities in the districts of Chicago, Ill., Detroit, Mich., Kansas City, Minneapolis, Minn., and St. Louis, Mo.



Robert P. Jones, assigned to the New York headquarters of Oakite Products, Inc.

OAKITE PRODUCTS, INC., New York City, has assigned ROBERT P. JONES—New England division manager since 1954—to the New York headquarters of the firm. Mr. Jones will do staff work for the company.

REVERE COPPER & BRASS INC., New York City, has appointed FRITZ



Fritz C. Hyde, Jr., newly appointed general sales manager of Revere Copper & Brass Inc.



Spindle Speeds

Horsepower

Torque

Finish

INFINITE

(from 43 to 3500 RPM)

CONSTANT

HIGH

ULTRA-SMOOTH

An exclusive coaxial spindle design combined with a unique, beltless-type, mechanical variator drive unit (5 HP), enables the Micro-Turn Lathe to deliver constant horsepower throughout entire speed range, actually maintaining drive speed output within two-tenths of one percent. Built-in torque responsive mechanism positively prevents slippage even under starting or shock loads. Maximum torque is assured at low speeds for heavy cutting, with super-smooth operation at highest speeds for ultra-fine finish, all complemented by the Micro-Turn's rigid construction and supreme balance.

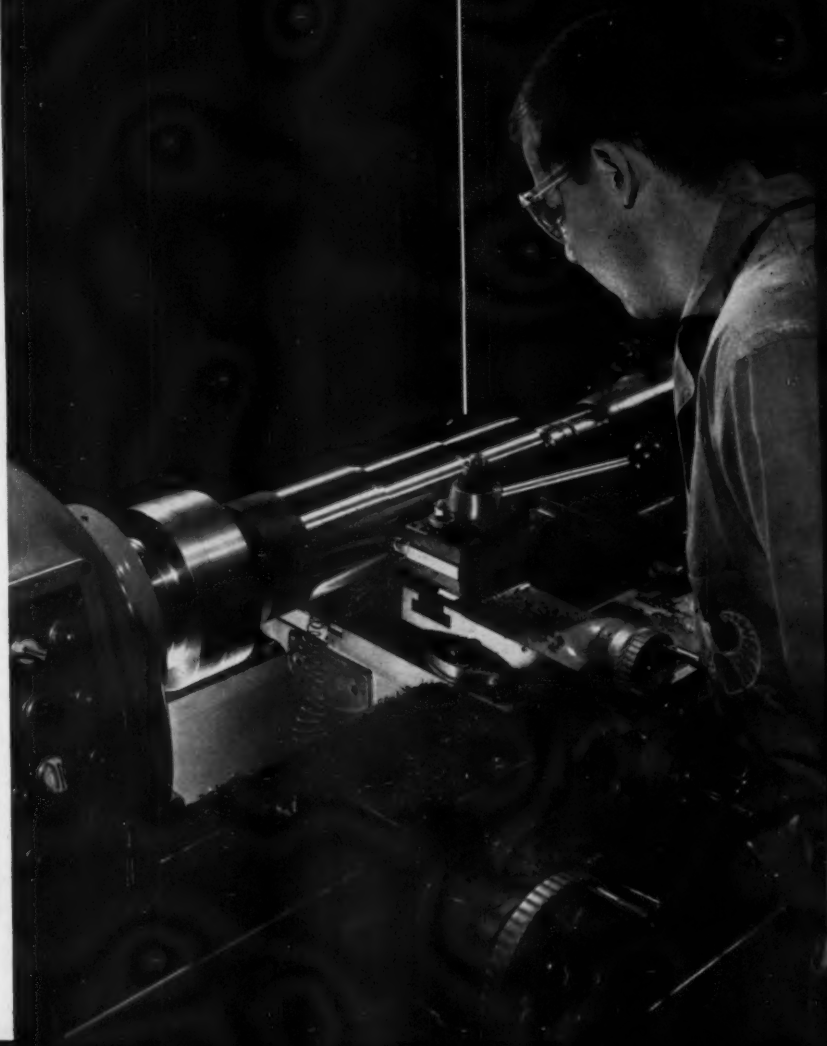
Features include:

- pushbutton control with direct reading tachometer
- spindle speed ranges changed by pushbutton . . . without stopping spindle
- exclusive feed converter unit, located in apron, providing simple conversion from standard to optional feed ranges without affecting standard thread ranges
- double-wall, one-piece, totally enclosed apron
- fail-safe pressure lubrication to headstock, gear box and end gearing
- pressure lubrication to carriage and cross slide ways provided by pump located in apron; one-shot plunger to lubricate cross slide ways when carriage is stationary
- choice of manual or automatic coolant operation
- hardened and ground leadscrew, cross feed screw and compound rest screw

For the complete, illustrated story on the revolutionary MICRO-TURN, write today for your copy of Bulletin No. 222. Nebel Machine Tool Corporation, Lathe Division, 3410 Central Parkway, Cincinnati 23, Ohio.

NEBEL
MICRO-TURN*
 HIGH SPEED PRECISION LATHE

*TM Reg. U.S. Pat. Off.



C. HYDE, JR., vice-president and formerly assistant general sales manager, general sales manager of the company. Mr. Hyde succeeds RAYMOND P. WINBERG, who is vice-president of foreign operations.

The AMERICAN SOCIETY OF MECHANICAL ENGINEERS has moved its headquarters' offices to the recently completed United Engineering Center. The address of the center is 345 E. 47th St., New York 17, N. Y.

LAURENCE D. GILLANE has been appointed BUTTERFIELD DIVISION

district manager of the middle Atlantic area by UNION TWIST DRILL Co., Athol, Mass. District headquarters are located in the firm's new and expanded warehouse at 47 Van Nostrand Ave., Englewood, N. J. Mr. Gillane will be responsible for the complete Butterfield sales, service, and warehousing program in that area.

J. J. RENDOS has been appointed assistant manager of the Cryogenic Engineering Department, Plainfield, N. J., of AIR REDUCTION SALES Co., New York City. Mr. Rendos will as-



J. J. Rendos, assistant manager, Cryogenic Engineering Department, Air Reduction Sales Co.

sist W. B. MOEN in operations covering the design and construction of major air separation and other related chryogenic facilities.

S. V. O'BRIEN has joined DIEHL MFG. Co., Finderne, N. J., as manager of material control. His responsibilities will include production control, purchasing, shipping, receiving, and warehousing.

Pennsylvania

BERYLLIUM CORPORATION, Reading, Pa., has announced the appointment of WALTER J. KOSHUBA to the position of plant manager of the company's Nuclear Division, Hazleton, and PHILIP H. SNYDER to plant manager of the Alloy Division at Reading. Mr. Koshuba comes to Beryllium from a position as manager—technical production for the Aircraft Nuclear Propulsion Division of GENERAL ELECTRIC Co. Mr. Snyder has been production manager of Beryllium's Nuclear Division fabrication plant since last April.

CARPENTER STEEL Co., Reading, Pa., has appointed VIRGIL W. GARDNER assistant to HAROLD R. POTTER, east-central regional manager. In his new capacity, Mr. Gardner will be assigned to special sales projects. In addition, THOMAS E. MURPHY has been promoted from assistant manager to manager of tool-steel sales.

WAGNER ASSOCIATES, INC., has announced the opening of offices in the Benson, Washington Lane at Township Line, Jenkintown, Pa., for the sale and distribution of machine tools. EARL PIERSON WAGNER, president of the firm, was treasurer of VANDYCK CHURCHILL Co., Inc.



BIG DIE CAPACITY

with Accuracy to Match

- Large bed and extra clearance between uprights provide space for large-area dies
- Reinforced Meehanite frame affords rigidity for high work accuracy and long die life
- Ideal for trimming die castings—standard slide face 18" x 11½"—bolster area 32" x 16½"—throat depth 9"—opening through back 21"
- 27-ton capacity covers wide range of light work requirements
- Basic design and construction insure efficiency and dependability
- Readily adaptable to special jobs at low cost
- Geared and non-geared models



WRITE for complete L&J catalog—14-to 150-ton O.B.I. Presses, 20-to 150-ton Straight Side Presses and 30-to 75-ton Gap Frame Presses.

L&J PRESS CORPORATION 1631 STERLING AVE. ELKHART, INDIANA

for aircraft quality welding without cleaning costs—



Aircomatic welding wire

Aircomatic (gas-metal-arc) welding wire is *chemically clean* when packaged . . . *chemically clean* when you open it . . . *chemically clean* when you use it.

Specify Aircomatic and you don't have to spend up to 20¢ a lb. to clean your wire. Just open the package, load your feeder and you're ready for aircraft quality welding.

You get X-ray quality deposits too . . . because the chemical composition of Aircomatic wire is rigidly controlled.

You get constant arc conditions and low electrical resistivity . . . because of uniform surface conditions of the wire.

You get a steady, uninterrupted feed rate when you use Aircomatic wire . . . because helix is low and wire finish is mirror smooth.

Another plus value . . . the tensile strength of Aircomatic wire is uniform. And, finally, wear on guide train and contact tube is minor when they're handling Aircomatic wire.

For current price schedule on Aircomatic quality finish aluminum, stainless, copper and steel welding wires . . . call Airco or look in your Classified Telephone Directory under "Welding Equipment and Supplies" for your nearest Authorized Airco Distributor.



AIR REDUCTION

The appointment of W. E. SHIPLEY MACHINERY Co., Philadelphia, Pa., as its authorized distributor for the Philadelphia and Baltimore, Md., areas has been announced by MOORE SPECIAL TOOL Co., Bridgeport, Conn.

Texas

CLECO AIR TOOLS, a division of REED ROLLER BIT Co., Houston, Tex., has added four new sales engineers. HUGH O. WEST has joined the Dallas office, while ROBERT C. SPOTT has been added to the firm's Newark, N. J., facilities. CHARLES McCLANAHAN will work in the San Francisco, Calif., bay area in the company's Burlingame office. In addition, DUDLEY GANG has been added to the firm's Toledo, Ohio, branch office.

CHARLES E. MILLER has been made Houston, Tex., district manager by CARPENTER STEEL Co., Reading, Pa. In his new position, Mr. Miller will direct sales in Texas, southern Mississippi, Louisiana, southern Arkansas, New Mexico, Colorado, Wyoming, and Montana.

Coming Events

OCTOBER 23-27-1961 Detroit Metal Show and ASM Materials Comparison Center, to be held in Cobo Hall, Detroit, Mich. For additional detail, contact William J. Hilty, exposition manager, American Society for Metals, Metals Park (Novelty), Ohio.

OCTOBER 23-27-Forty-Third National Metal Congress, presented by the American Society for Metals and eight participating organizations, to be held in Cobo Hall, Detroit, Mich. For more information, contact T. C. DuMond, manager, metal congresses, American Society for Metals, Metals Park (Novelty), Ohio.

New Books

AMERICAN STANDARD SPECIFICATIONS FOR SHAPES AND SIZES OF DIAMOND GRINDING WHEELS, HAND HONES AND MOUNTED WHEELS, ASA B74.3-1961. 37

pages; 8 1/2 by 11 inches. Published by Grinding Wheel Institute, 2130 Keith Bldg., Cleveland 15, Ohio. Price, \$1.50.

This publication lists standard sizes of diamond grinding wheels, hand hones, and mounted wheels, in addition to the standard shapes as established in the American Standard Identification Code for Diamond Wheel Shapes, B74.1-1957.

AMERICAN STANDARD GUIDE FOR SELECTING GREEK LETTERS USED AS LETTER SYMBOLS FOR ENGINEERING MATHEMATICS, ASA Y10.17-1961. 4 pages; 8 1/2 by 11 inches. Published by the American Society of Mechanical Engineers, United Engineering Center, 345 E. 47th St., New York 17, N. Y. Price, \$1.

This standard is a guide showing those forms of Greek letters particularly applicable to engineering mathematics because of their recognizable difference from other Greek and Latin letters. It is intended for authors; editors; printers; and manufacturers of type, typewriters, lettering guides, and similar aids.

MILLS TO .0001" ...

Precise

finishes under 10 microinches!

PRECISE HIGH RPM MILLING MACHINES



Compact, universal production machine tools for high precision milling. Ideal for accurate production of sub-miniature, optical and instrument components as well as larger parts used in hydraulics, aircraft, missiles. Uses carbide midget mills up to 3/4" diameter and grinding wheels up to 2" diameter. Precise Milling Machines are available in two models... with a power range from 1/2 hp to 2 hp, and an infinitely variable speed range from 7,200 to 54,000 rpm. Both models can be furnished with Precise Universal Power Quills or Super Cycle Power Quills.

Precise

Grinder-Millers, Power Quills, Jig Grinders, Milling Machines, Automatic Drill Units, Cutting Tools, Vapor-Lub Cooling, Skiero Hardness Tester.
Quality and Precision Since 1882

PRECISE PRODUCTS CORPORATION
3751 Blue River Road, Racine, Wisconsin, U.S.A.
Branch Plant: Precise, G.m.b.H., Duesseldorf, Germany

P106

For more data, circle Item 244A on Readers' Service Card

MAKE PRECISION KEYWAYS with KEYSEATERS



Model No. 25
2 1/2-in.
Capacity

Versatile, heavy-duty Star machines produce precision keyways in a minimum of time. Proven overarm bushing support and motorized pull-down reciprocating cutter bar action assures maximum keyway accuracy and alignment. Wedge-locked H.S.S. form tools in stock sizes from 1/8-in. to 3-in. width fit seven standard bar sizes up to 2-7/16-in. diameter. Stroke adjustable up to 24-inches. Automatic work table feed and backoff. Tilting table. Overarm column movable for cutting keyways opposite spokes.



Model No. O
1-in.
Capacity

Star Cutter Company

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For more data, circle Item 244B on Readers' Service Card

You name it...we'll forge it!



RIGHT ON THE NOSE. Bethlehem meets your specifications exactly on all types of press, drop, and hammer forgings.

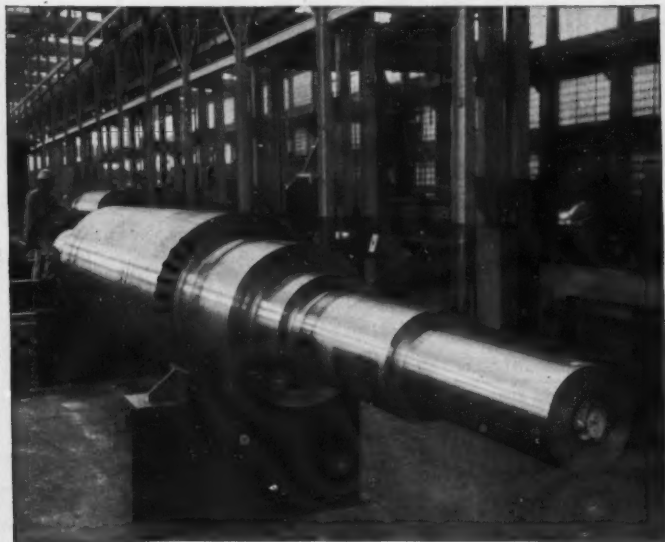
*for Strength
... Economy
... Versatility*



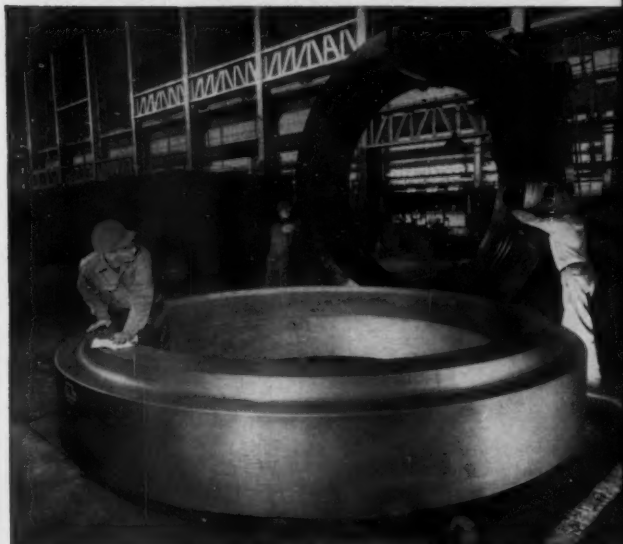
RAM ADAPTER. This forging weighs 58,780 lb, and measures 140 in. x 73 in. x 25 in.



STEEL CYLINDER for use in 7,500-ton plate stretcher. This forging weighs 171,240 lb, and it's 17 ft, 3 in. long.



GENERATOR SHAFT. Weight, 198,240 lb. As you can tell from these photos, Bethlehem is well-equipped for machining.



REACTOR VESSEL CLOSURE. The OD of this 50,660-lb forging measures 12 ft.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA. *Export Sales:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL



WHAT'S YOUR SHOP COST PER HOUR FOR WAGES AND OVERHEAD?

If it's \$6.00 you spend 10 cents per minute.
If it's \$7.20 you spend 12 cents per minute.



3 cuts = 6 finished ends.

Cuts like these are
made in **SECONDS!**

\$6.00 per hour =
1/6 cents per second.

\$7.20 per hour =
1/5 cents per second.

WHEN YOU CAN CUT AND
FINISH LIKE THIS (Total time 58 seconds) THAT'S
FAST! WHY DON'T YOU INVESTIGATE TO SEE WHAT
YOU ARE MISSING.

Write and ask about "Cut-Machining."

WALLACE SUPPLIES MFG. COMPANY

1310 W. Diversey Parkway, Chicago 14,

or Check Item 246A on card.



Stahl's production facilities, skill and experience were responsible for the quick delivery of these bull and clutch gears. Intended for use in rubber machinery, they will provide the long-wearing, accurate performance characteristic of all Stahl-made gears—large or small. For your next gear needs contact Stahl.

Stahl

GEAR & MACHINE COMPANY

3901 Hamilton Ave. Cleveland 14, Ohio

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246

SPURS TO 72" PD, 1 DP
BEVELS TO 54" PD, 1 DP
SPIRAL, HELICAL and WORM GEARS
TO 48" PD, 2 DP
CONTINUOUS-TOOTH HERRINGBONE
TO 60" PD, 2 DP
SPROCKETS TO 72" PD, 2 1/2" CP
RACKS TO 20 FT. LONG, 3 DP
SILENT GEARS:
RAWHIDE, BAKELITE, FIBROIL
HEAT-TREATED, CASE OR FLAME
HARDENED GEARS—
OF CARBON OR ALLOY STEEL

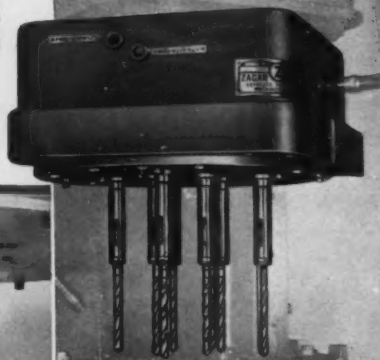
NEW NEW Slip Spindles

ON
**ZAGAR
HEADS**

for
drilling,
reaming,
tapping



Spindle locations can be changed quickly, easily, on Zagar gearless heads. Rigidity is retained in a compact, low height head. Varying patterns can be economically machined with one head, adaptable to any standard drill press.



A minimum of spindle extension
keeps head height down.

WRITE FOR BULLETIN M-5710

23888 LAKELAND BLVD. • CLEVELAND 23, OHIO

Zagar

USE MORE SPINDLES TO DO MORE WORK

For more data, circle Item 246C on Readers' Service Card

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Edited by Holbrook L. Horton

MACHINERY'S MATHEMATICAL TABLES has been serving mechanical engineers, machine designers, draftsmen, toolmakers, machinists and students for over 30 years! Now it is available in a greatly enlarged version, containing the authoritative, easy-to-use mathematical regular information you need on the job. Designed for speed and utility, you can now use its "edge index" to flip to any desired place in the book instantly.

The convenient pocket-size, its semi-flexible covers, and thin strong pages make it the ideal everyday reference book to have. 254 pages. \$3.75

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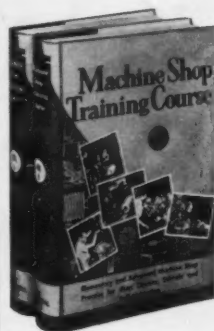
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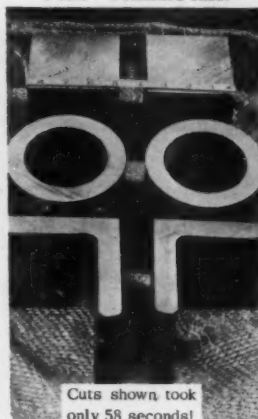
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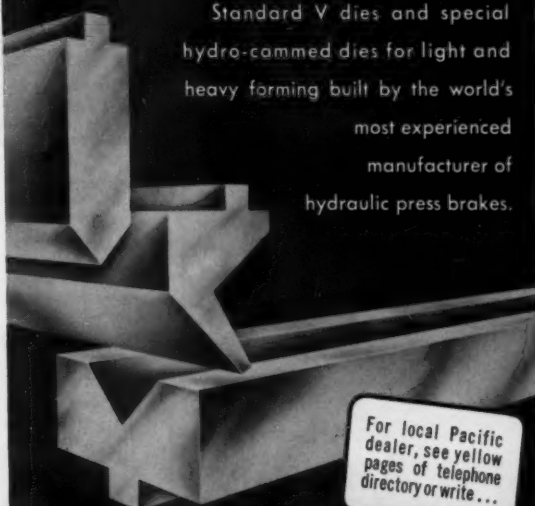
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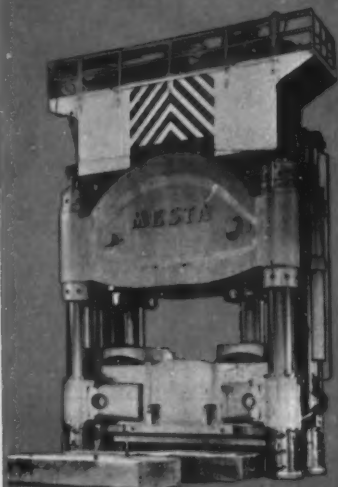
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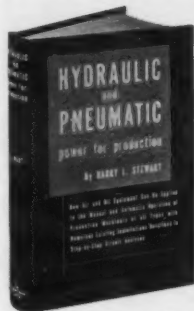
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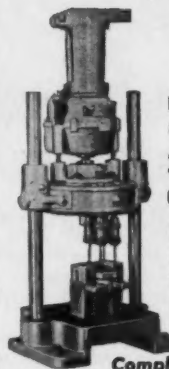
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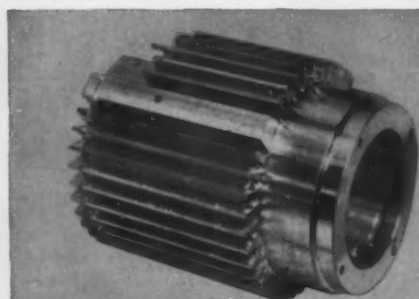
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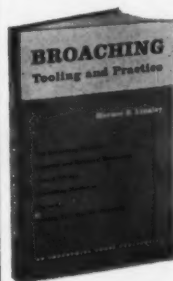
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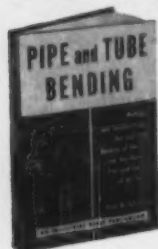
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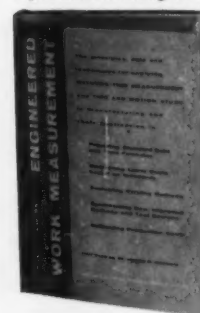
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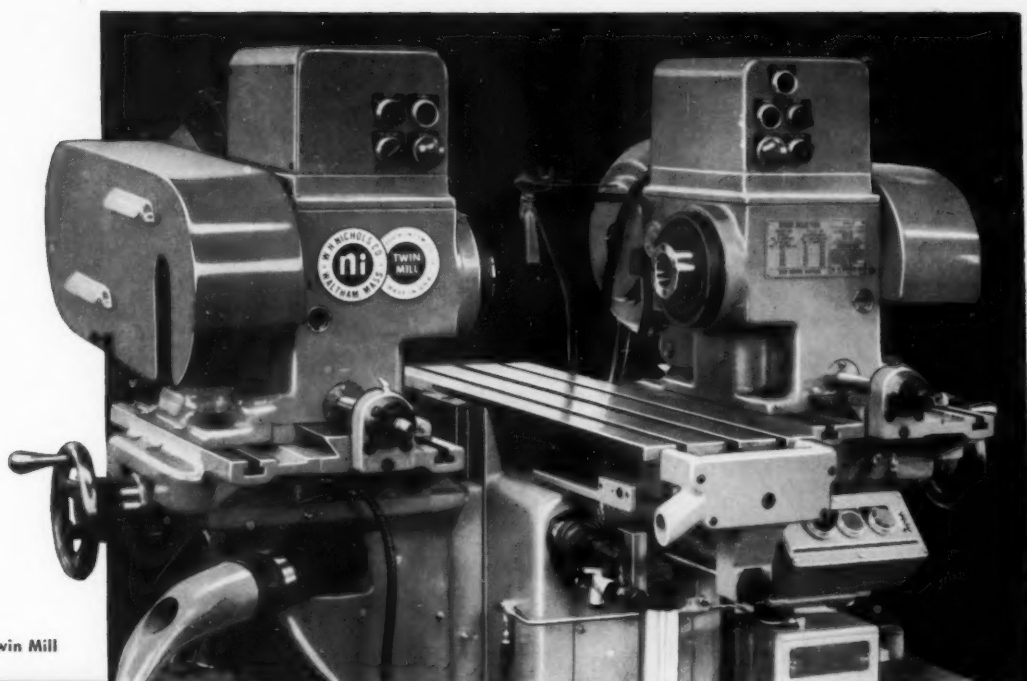
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